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ABSTRACT

A demonstration project explored the potential of satellite video consulation to improve the quality of rural health care in Alaska. Satellite ground stations permitting both transmission and reception of black and white television were installed at clinics in Fairbanks, Fort Yukon, Galena, and Tanana. Receive-only television capability was installed at the Alaska Native Medical Center in Anchorage. As part of the project, a centralized, computer-based, problem-oriented medical record system, called the Health Information Systems was introduced. Satellite video consultation was shown to be useful for practically any medical problem, crucial to some cases, and usable by health care providers at all levels of training. The Health Information System was judged valuable by all participants in the demonstration, and it was recommended that it be established permanently and expanded to the entire state of Alaska. Forms used and data are included. (Author/PF)

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# TELEMEDICINE IN ALASKA:
# THE ATS-6 SATELLITE BIOMEDICAL DEMONSTRATION

Final Report of the Evaluation of
the ATS-6 Biomedical Demonstration in Alaska

by

Dennis Foote, Edwin Parker, and Heather Hudson

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Ft. Yukon clinic showing ATS-6 transmit and receive stations.

Galena clinic showing ATS-1 antenna.

Dr. Britton consults from Tanana over ATS-6.

Dr. Britton talks to a health aide via ATS-1.

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Patient waits for consultation in Ft. Yukon clinic.

Nurse Hilda Silva shows deep foot wound.



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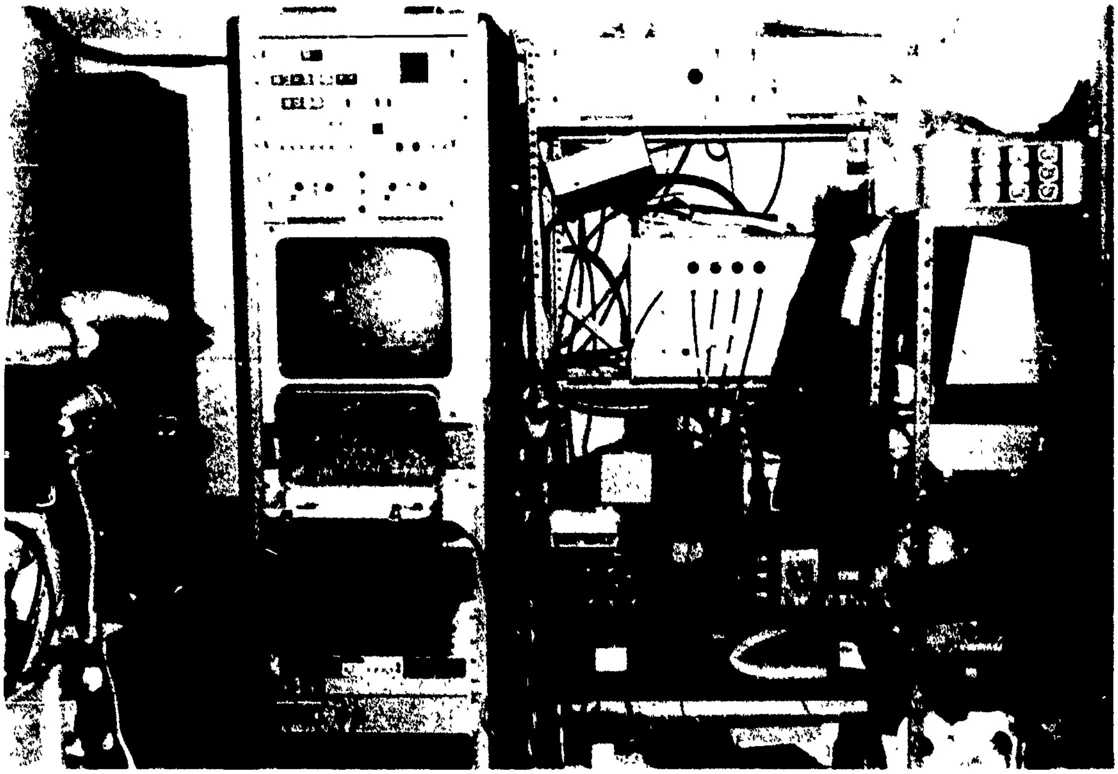
A baby is shown from Ft. Yukon.

Nurse Hilda Silva presents an x-ray.



ATS-6 equipment in the Galena clinic.

Medex Dennis Bruneau talks from the Galena clinic.
(ATS-1 antenna is visible through the window.)

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## EXECUTIVE SUMMARY

This document summarizes the final report of the evaluation of the Applications Technology Satellite-Six (ATS-6) Biomedical Demonstration in Alaska, one of several Health-Education-Telecommunications (HET) demonstrations on that satellite sponsored by the U.S. Department of Health, Education and Welfare. The biomedical demonstration in Alaska was jointly sponsored by the Indian Health Service and the Lister Hill National Center for Biomedical Communication. The evaluation was conducted by the Institute for Communication Research at Stanford University, under contract to the Lister Hill Center.

The primary purpose of the demonstration project was to explore the potential of satellite video consultation to improve the quality of rural health care in Alaska. As part of the project, a centralized, computer-based, problem-oriented medical record system was introduced. The demonstration was conducted in the Tanana Service Unit of the Alaska Area Native Health Service.

Satellite ground stations permitting both transmission and reception of black and white television were installed at four locations in the Tanana Service Unit -- Fairbanks, Fort Yukon, Galena, and Tanana. Receive-only television capability was installed at the Alaska Native Medical Center in Anchorage. All five sites had two-way audio capability. The Fairbanks Native Clinic did not participate in the demonstration because of staff shortages at the clinic and because specialist consultants were available in Fairbanks, making teleconsultation capability less relevant to the needs of Fairbank patients.

Two of the locations were in communities without a resident physician -- Fort Yukon and Galena. In most of the consultations, patients at these two remote sites were seen by physicians at the Service Unit Hospital at Tanana or by medical specialists in

Anchorage. In some consultations, patients at the Tanana Hospital were seen by specialists in Anchorage. Simultaneous two-way video capability was not available, although the one-way video could be switched to permit transmission from any site except Anchorage. Transmission from the hospital to the remote clinics was used primarily for educational programs.

The results of this evaluation should be interpreted in context. The demonstration was an exploratory field trial, not a rigorous experiment. A relatively small patient population was served and the communities involved are not completely typical of other settings, even in Alaska. The availability of the satellite limited the demonstration to a fixed schedule of three hours per week for a period of nine months. There were concurrent changes in the health care system and the social environment that might distort or obscure the effects of the video consultation service. These constraints complicated the conduct of the demonstration and its evaluation; they should also guide interpretation of the results. Despite the limitations, much valuable information about the difficulties and advantages of video teleconsultation and its possible implementation in Alaska was gained. Introduction of the telemedicine service into the realistic setting of an on-going health care delivery system in Alaska permitted valuable experience to be gained that would not have been possible in a more tightly controlled experiment in a different setting.

## CONCLUSIONS

1. Satellite communication using small ground stations for audio and black and white television transmission can reliably provide signals of sufficient quality to be useful in the health care delivery system in rural Alaska.

The quality of signal obtained in this demonstration was suitable for the great majority of medical cases encountered. The basic satellite equipment, while complex, is not too sensitive for

operational use by non-technicians even under demanding environmental conditions, provided that adequate arrangements are made for technical maintenance and repair. Equipment down-time in this demonstration was primarily due to the length of time taken to diagnose and repair equipment problems rather than to persistent malfunctions. In an operational setting the larger scale, greater experience, and unambiguous locus of responsibility for maintenance would avoid some of the equipment problems that occurred in this limited-duration small-scale first-time demonstration.

2. Useful consultations for practically any medical problem can be conducted using satellite video channels.

During 104 scheduled transmission days, approximately 325 video consultations were conducted. The range of diagnoses was very wide and included "sensitive" health problems such as genital-urinary problems that one might expect to be omitted from video consultations. The patients came from every age bracket and practically every community in the Tanana Service Unit. More than 75% of the cases occurred in five categories: follow-up visits, accidents, musculoskeletal problems, skin problems, and infective or parasitic diseases. The system was also used for transmission of X-rays and EKGs from remote sites and for transmission of educational material from the Tanana Hospital. Most of the consultations were for evaluation of minor problems, but 13% were judged "moderately severe" by the physicians. Relatively few critical or emergency cases were involved, probably because emergencies cannot wait for scheduled transmission times. A system with 24-hour-a-day, seven-day-a-week capability would be likely to have a different pattern of use.

3. Satellite video consultation can be successfully carried out by health care providers at all levels of training.

Village health aides from Galena, Huslia, Nulato, and Venetie were able to present their patients without difficulty over ATS-6 from Fort Yukon and Galena. A medex and nurses also used the system for successful consultations with primary care physicians in Tanana and medical specialists in Anchorage. Physicians in Tanana made use of the system to present patients to Anchorage for specialist consultation.

> 4. The unique capabilities of the video transmission may play a critical role in five to ten percent of the cases selected for video presentation. Otherwise, there was little measurable difference between the effect of video and audio consultation.

Cases selected for television were slightly more complex or severe than those discussed over audio channels. The kinds of cases that are difficult to handle over video are also difficult to handle with audio-only consults. Video consultations took longer (12 to 15 minutes) than audio consultations (3 to 6 minutes). The initial diagnosis is changed by the consulting physician after the video consult more often than following audio consults, but this difference appears to result solely from fewer "routine" cases being presented for video consultation. The level of change in management plan is the same for video as for audio consultations.

The consultant physicians recorded their best judgment of the probable effect that each consultation would have on the medical outcome for the patient. These ratings indicate that about half of all the consultations via any medium should have a more than symptomatic effect on the medical outcome for the patient. However, these ratings show no difference between telephone, satellite audio, and satellite video consultations on the patient's expected eventual health status. A physician observer judged that the visual information may play a critical role in about five percent to ten percent of the cases selected for video consultation.

5. The health care providers involved in the demonstration generally felt that the video consultations improved the capabilities of the health care system, but questioned whether the improvement was worth the additional cost or inconvenience. They placed much stronger emphasis on implementation of reliable operational audio channels which they consider absolutely essential to delivery of health care in rural Alaska.

The health care providers felt that the benefits of reliable voice communication compared to the previous absence of any reliable communication were so great that the additional benefits of video appeared small by comparison. Most communities in the Tanana Service Unit have neither roads nor telephones; their only reliable means of communication is the experimental ATS-1 satellite, which is long past its life expectancy and is without a back-up in the event of failure. Termination of that capability through technical failure or administrative decision would be a major set-back for health care delivery in the Tanana region. (At the outset of the demonstration, some of the native leaders were reluctant to have their communities involved in a nine-month demonstration that provided little possibility of continued service. They agreed to support the ATS-6 demonstration in part because it would continue to focus attention on the need for reliable voice communication.)

6. The Health Information System (HIS) was judged by all participants in the demonstration to be a valuable addition to the health care delivery system that should be continued in the Tanana Service Unit and extended to other parts of the State.

The computerized problem-oriented medical record system with revised medical forms and paper and microfiche output was universally judged to be a significant improvement in the quality of health care delivery in the Tanana Service Unit.

The providers saw the format and structure provided by the input forms, the organization of the patient summaries, and the

availability of records from other locations as major advantages of the new system. They felt that bi-weekly updates of their copies of patient summaries were sufficiently frequent for most outpatient care.

## RECOMMENDATIONS

The full report concludes with a chapter titled, "Implications for Operational Service and Future Research." It reports technical possibilities and cost estimates for possible future operational systems, so that policy makers can review for themselves both the potential benefits and the probable costs of possible next steps. The most promising areas for further research are also discussed. In the light of these technical, cost, and research considerations, nine major and fourteen minor recommendations are made in that chapter.

The nine major recommendations are:

Recommendation 1: The Indian Health Service should continue to assign top priority to implementing reliable operational voice communication reaching all communities in Alaska.

Recommendation 2: The Health Information System (HIS) should be maintained on a permanent basis in the Tanana Service Unit and should be expanded as rapidly as possible to the rest of Alaska.

Recommendation 3: The Indian Health Service should begin field tests of slow-scan video, medical telemetry, facsimile, and data transmission techniques using voice grade (narrow-band) channels.

Recommendation 4: Because operational two-way motion video services throughout Alaska are currently neither technically nor economically feasible, such service should not be considered by the Indian Health Service at this time. Information useful for planning possible future services could be obtained from an experimental video linkage permitting medical specialists at Anchorage to view patients at Bethel.



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Recommendation 5: The Indian Health Service should work closely with other agencies and organizations sharing common interests and objectives in planning satellite communication systems for health service delivery, including the Public Service Satellite Consortium. This activity should include the preparation of technical plans and cost projections associated with different possible uses of video ranging from limited experimentation to full-scale statewide implementation of one-way video transmission (for education programs) and two-way video linking most Alaska locations for operational video telemedicine services.

Recommendation 6: Health care planners outside Alaska should seriously consider health care delivery systems in which the primary provider is both geographically and culturally close to the client population, using communication technology to obtain consultation from physicians. The favorable results in Alaska deserve to be copied elsewhere.

Recommendation 7: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development activities leading to improved-capability and reduced-cost terminals for multi-function and time-shared use of audio channels.

Recommendation 8: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development leading toward time-sharing and bandwidth-sharing techniques for more efficient use of audio and video channel capacity.

Recommendation 9: Technical research and development activities intended to improve the quality of health care should, like this ATS-6 project, have close contact with the physical, social, and human environments in which any resulting innovations are intended to be located.



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CHAPTER ONE

# INTRODUCTION

This document is the final report of the evaluation of the Applications Technology Satellite Six (ATS-6) Biomedical Demonstration in Alaska, one of several Health-Education-Telecommunications (HET) demonstrations sponsored by the United States Department of Health, Education and Welfare. The HET demonstrations utilized the ATS-6 satellite of the National Aeronautics and Space Administration (NASA) after the successful launch on May 30, 1974 and later positioning into orbit at 94 degrees west longitude, until mid-May 1975. At that time the satellite was moved for use in an educational television demonstration in India.

The Biomedical Demonstration in Alaska was jointly sponsored by the Indian Health Service and the Lister Hill National Center for Biomedical Communication. The evaluation was conducted by the Institute for Communication Research at Stanford University, under contract to the Lister Hill Center. Implications can be drawn from the demonstration for operational health care delivery systems throughout Alaska and in other parts of the world, as will be discussed below.

The remainder of this chapter reports background information about the Alaska health care setting where the demonstration took place and where operational changes resulting from its lessons could occur. It also provides descriptive information about the demonstration itself. Later chapters describe the methods and results of the evaluation study. A concluding chapter discusses the implications of the demonstration results in the light of cost estimates for operational implementation and makes recommendations for transition of some features of the demonstration into operational service and for further research and development of other potentially useful features.

## 1.1 THE ALASKAN HEALTH CARE ENVIRONMENT

### 1.1.1 The Land and the People

The Alaskan environment, renowned for its severe climate, may also be characterized by its vastness and its diversity. Its over 500,000 square miles include coastal rainforests, glaciers, the highest mountains on the continent, broad river valleys, and barren tundra. The northern environment is one of severe winters, extended periods of darkness and of daylight, and intense but fleeting beauty.

The resident population of Alaska is about 350,000, of whom about 55,000 are Indians, Eskimos, and Aleuts. Most of this native population lives in widely scattered villages of 25 to 500 people. Village housing is typically without electricity, running water, or sewage systems. Rural unemployment is high, and welfare support prevalent. Much energy is spent in adapting to the rigors of the environment, which makes conventional means of communication and transportation difficult and unreliable. Travel between remote communities is primarily by bush plane. Storms, extreme cold, and rough, unlighted airstrips make flying hazardous and at times impossible. Difficulties in transportation make communication extremely important. Help must often be sought without the possibility of traveling to the source of assistance. And yet here again the environment is a hindrance.

One of the most beautiful northern sights is the Aurora Borealis, or northern lights, but the very ionospheric disturbances that create the aurora wreak havoc with radio signals. Communities dependent on high frequency radio telephones for communication may be cut off for days or even weeks at a time. And the transportation problems mean that maintenance of equipment tends to be spasmodic, and repair of malfunctioning equipment a time-consuming process.

### 1.1.2 History of Health Care Services

The mid-1700s brought whaling, fur trading, and Russian exploration to Alaska. Along with these cultural and social changes came measles, tuberculosis, and venereal diseases.

Prior to the mid-1860s, traditional medicine as practiced among the native people was the mainstay of their health care. After the Alaska purchase, such non-traditional health care as was available was provided by the Public Health Service physicians assigned to revenue cutters that patrolled the Bering Sea.

From 1889 until 1931, the responsibility for native health care was assumed by the U.S. Bureau of Education. In 1931 the U.S. Bureau of Indian Affairs (BIA) assumed the responsibility for native health care as a secondary component to their primary responsibility of education, economic development, and welfare for the Alaska natives (Wilson, 1972). Public health nursing services to natives were provided by itinerant BIA nurses associated with the BIA hospitals located throughout the Territory (Albrecht, 1975).

By this time, Alaska had been through the gold rush, the First World War, and the worst of the Great Depression. A number of missionary physicians and private practitioners had come to Alaska to work. With the settling of the Matanuska Valley (near Anchorage) in 1935, more private practitioners came to Alaska. In the late 1930s and early 1940s, the legislature of the Territory of Alaska appropriated monies to support a Department of Health. Territorial Public Health Nurses (PHNs) began to extend general public health services to all Alaskans located in rural and urban areas of the Territory (Albrecht, 1975).

When Alaskans had to prepare for World War II in the early 1940s, the Fort Richardson Hospital was established and health care was made available to military beneficiaries throughout the Territory.

In 1955 the U.S. Public Health Service (USPHS), Division of Indian Health (later named the Indian Health Service), assumed responsibility for health care of Alaskan natives. (The branch of the IHS serving Alaska is the Alaska Area Native Health Service.) The old BIA hospitals were turned over to the PHS, and a system of health care delivery was developed utilizing village health aides and service unit hospitals serving seven geographic areas. In 1965,

the Alaska Native Hospital in Anchorage became the Alaska Native Medical Center and an increasing complement of specialty services was offered to the outlying service units over the ensuing years.

The post-war years brought an accelerated rate of change to Alaska. The native people were forced to seek their livelihood in a money economy for which they were ill-prepared. The involvement of federal agencies in the state increased, with the federal government being one of the largest employers. Statehood in 1959 brought new responsibilities and reorganization.

The Native Land Claims Settlement Act provided possibilities for native people to once again assume control of their own destiny. Native regional corporations were formed by Eskimos, Indians, and Aleuts. These corporations are represented in the Alaska Federation of Natives (AFN). The regional corporations support both a profit arm that deals with economic development and a non-profit arm that is concerned with social services, including health care needs of the native people. It is well understood that the native people wish eventually to control their own health care delivery systems. When this transfer of control will take place and what form the resulting health care system will take are yet to be determined.

The most significant recent event affecting Alaskans has been the massive project to build the Alaska oil pipeline. Thousands began to come to Alaska to find their pot of "black gold." The Alaska native people had to vie once again for the right to participate in the work and benefits generated by Alaskan natural resources. Inflation fueled by the flow of oil money through the State has strained an economy already burdened by the needs of the "have not" people for welfare, general medical relief, food stamps, or other available government-supported assistance.

Changes are taking place in the health care delivery system for native people as well. Many native people are now eligible for state medical assistance programs, and may choose to go to private practitioners.



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In 1969 the native people formed health boards as a mechanism for native involvement in advising the Alaska Area Native Health Service and setting policy for the health care system. Regional boards each appoint a member to the statewide Alaska Native Health Board. These boards have assumed responsible roles in all phases of health care (Wilson and Brady, 1975).

### 1.1.3 Alaskan Health Care Services Today

Alaskan health care delivery systems have grown into a complex and interrelated amalgam of individual practitioners, groups of health care practitioners, agencies, institutions, and local/state/federal systems. Today, the Alaska Area Native Health Service is a well developed institution geared to the provision of health care services to native people throughout the state. Its structure will be outlined below.

Alaskan natives receive free care from the Alaska Area Native Health Service. However, in recent years many have found that they also qualify for other assistance programs such as Medicare and Medicaid. Under these programs, they are able to obtain medical service from private practitioners.

Because of the complexity of Alaskan health systems and the eligibility of Alaskan natives for assistance from various programs, it is important to summarize the institutions which provide health care in Alaska.

Rather than simply listing these institutions, Dr. carolyn Brown presents them from the consumer's point of view by identifying various categories of consumers and the services available to them:

| Consumer Category | Examples of Available Services |
|---|---|
| Those who are special beneficiaries, e.g., Alaskan natives, military veterans, etc. | Public Health Services, Medicare, military health services, state programs |
| Those who can pay the "usual and customary fee" | Private medical care |



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| [Consumer Category] | [Examples of Available Services] |
|---|---|
| Those who cannot pay anything | Medicaid, General Medical Relief |
| Those who can pay part of the health care cost | Neighborhood health centers and dental clinics |
| Those who are enrolled in special health care programs | Third party insurance programs |
| The public in general which is entitled to certain public health and preventive services | State and local health department services in venereal disease control, immunizations, tuberculosis screening and management, family planning, well-child clinics |

In addition, Dr. Brown adds another category of consumers, the "marginally indigent," who are caught between the systems because they do not know that they have access to care. It should be noted that these categories are not mutually exclusive. Everyone is eligible for some preventive care services. And many people, including Alaskan natives, may qualify for health care through several systems.

1.1.3.1 The Alaska Area Native Health Service

The PHS facilities in Alaska are administered by the Alaskan Area Native Health Service, a part of the Indian Health Service. Administratively, Alaska is divided into seven service units, each with a regional hospital. Approximately 80 physicians work at these hospitals and outpatient facilities as commissioned officers or civil service employees of the PHS. The Alaska Native Medical Center, the hospital for the Anchorage region, is also the major referral hospital for the State.

Primary health care in the villages is generally provided by native health aides who are nominated by the village councils and employed by the regional native social service organizations using PHS funds. Basic training is provided by the PHS at the Alaska Native Medical Center. More advanced training is done in follow-up courses at Anchorage or on site in the villages.



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The health aide returns to the village with basic tools: a drug kit, instruments, reference manual, and a communication link to the service unit hospital. Doctors at the service unit hospitals attempt to maintain daily contact with the village health aides in their regions.

Some larger villages (e.g., Fort Yukon) are served by a registered nurse or other clinical personnel. Clinics have been constructed by some communities (e.g., the new clinic in Galena); in others, the clinic is located in the school or other public building. In many cases the health aide works out of his or her home.

About once per month nurses and/or doctors visit the villages to provide ambulatory care and preventive treatment. Specialists from Anchorage make regularly scheduled visits to the service unit hospitals and less frequent trips to the villages as required.

### 1.1.4 Health Status of Alaskan Natives

In the 21 years that the Public Health Service has been responsible for medical services for native people in Alaska, there has been a dramatic improvement in the physical well-being of its clients. The main problems cited in the 1954 Parran Report (referred to by the name of the team leader, Dr. Thomas Parran) were tuberculosis, maternal and child health, mental health, environmental health, and dental health (Kreimer et al., 1974).

In 1973, the Alaska Native Health Service reported on the advances it had made in these areas (Lee, 1973). Tuberculosis, which had been the cause of one-third of the native deaths, had been practically eradicated, and deaths from other infectious diseases and diseases of pregnancy and childbirth which had been 10 times that of U.S. whites in 1954 were only 1.5 times higher in 1972. Infant mortality was also reduced, so that whereas in 1950, 10% of the newborn died before their first birthday, in 1970 only 3% of native babies died in their first year.

However, the system had been less successful in coping with mental health problems. The rapid rate of change in the past 20

years has led to increased sociobehavioral problems, reflected in increased rates of death from alcoholism, suicides, and homocides, and in the increasing proportion of hospital admissions resulting from accidents, psychological disorders, and abortions.

Sociobehavioral problems such as alcohol and drug abuse are recognized as critical problems, but ones to which no adequate solution has been found (see Chapter 9). Dental care provided by the PHS remains inadequate, and is recognized as a health priority by native people (Federal Programs and Alaska Natives, 1975).

Leading causes of death in 1971 were:*

| Cause of Death | % of Total Deaths |
|---|---|
| Accidents | 27% |
| Malignant neoplasms | 11% |
| Heart disease | 10% |
| Alcoholism | 6% |
| Influenza & pneumonia | 6% |

The accidents, heart disease, and alcoholism may all be reflections of the pressure of cultural transition and rapid social change being forced on Alaskan natives by the pace of economic development and outside involvement in the state.

The leading causes of hospitalization ranked in order of frequency of discharge diagnosis were: (1) accidents; (2) delivery; (3) otitis media; (4) diseases and conditions of the eye; (5) abortion; (6) symptoms, senility and ill-defined conditions; (7) diseases of breast and female genital organs; (8) diseases of stomach and duodenum; (9) psychotic, psychoneurotic, and personality disorders; and (10) alcoholism ("Leading Problems ...," 1973). Between 1966 and 1972, the number of inpatient days decreased by 38.2% and the average length of stay had dropped from 19.3 days to 11.0 days (Kreimer, 1974).

In contrast, there was a 48% increase in the number of outpatient visits between 1966 and 1970, attributed to increases in

*From "Leading Health Problems of the Alaskan Native," 1973.



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emphasis on primary prevention, secondary prevention through early diagnosis and treatment, and maintenance care of those with chronic diseases (Kreimer, 1974). The leading causes of outpatient visits ranked in order of total diagnosis for 1973 were: (1) accidents; (2) URI and common colds; (3) acute otitis media; (4) prenatal care; (5) pharyngitis and tonsillitis (non-strep); (6) chronic otitis media; (7) hypertensive disease; (8) eczema, urticaria, and skin allergies; (9) strep throat; and (10) urinary tract infections ("Leading Problems ...," 1973).

1.1.5 Status of Communication Facilities

1.1.5.1 Non-satellite Services

Major cities and towns in Alaska have telephone exchanges and long distance service. Villages along highways generally have phone service. Some villages in the Bethel region have "bushphone" service, one VHF circuit per village.

In approximately 100 other villages, however, the link takes the form of a high frequency radio telephone. These HF radios tend to be unreliable because of ionospheric interference, lack of regular servicing, and inadequate training of local people in operation techniques and basic maintenance.

However, accessibility is another factor which must be taken into account in discussing Alaskan communication facilities. In many villages the aide must use a radio owned by another agency such as the BIA or State-operated schools. This radio may be located in a school or a teacher's home, where the aide may hesitate to request daily access. Schools where radios are located may be locked for the summer months. In villages with health clinics, the radio may be in the clinic. Although this radio is accessible while the aide is at the clinic, it cannot be monitored at other times.

Accessibility may be a problem even in villages with a telephone. Communities with "bush telephone" service have only one telephone in the village. This telephone is located in a public place such as the general store. The aide cannot use the



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phone from her home or the clinic, and is afforded little privacy when she uses it in the store.

The larger Alaskan villages and those close to military installations have local exchanges which interconnect to the state long distance telephone system. All three villages participating in the ATS-6 demonstration (Fort Yukon, Galena, and Tanana) have local telephone exchanges.

1.1.5.2 Satellite Communication via ATS-1

In 1971, Alaska gained the opportunity to see if reliable communication would help to improve village health care. Twenty-six sites in Alaska were chosen to participate in an experiment in satellite communication. The experiment was financed by the National Library of Medicine's Lister Hill National Center for Biomedical Communication. It used ATS-1, first in NASA's series of Applied Technology Satellites launched in 1966 with a life expectancy of two years. Solar cells permit recharging of the satellite's batteries which power the VHF transponder. NASA's ATS-1 satellite was made available for the experiment in 1971, and was still in use in late 1975.

Twelve of the sites selected were in the Tanana Service Unit. Nine were villages without reliable communication. The other three were at Tanana where the service unit hospital is located, at Fort Yukon, a village with telephone service, and at the University of Alaska near Fairbanks. Ground stations costing about $3,000 each were installed for the project by the University of Alaska's Geophysical Institute, working under contract with the Lister Hill National Center for Biomedical communication. In addition to the villages and hospital in central Alaska, ground stations were also installed at the other service unit hospitals, the Alaska Native Medical Center in Anchorage, and St. Paul in the Pribilof Islands.

Ground stations at hospitals which did not use the satellite frequently were later moved to other villages in the Tanana

Service Unit. By the fall of 1974, the number of sites in the Tanana Service Unit had increased from 12 to 17.

1.1.5.3 Tanana Doctor Call

Each weekday, doctors at service unit hospitals attempt to contact the health aides at villages in their unit by telephone or two-way radio. The Tanana Service Unit in central Alaska has been notorious for its poor radio communication. Problems include low reliability, aggravated by long distances and the mountainous terrain of the Brooks Range, and inaccessibility of radios located in schools and teachers' homes.

The major demonstration involved daily consultation by satellite between doctor and health aide in the Tanana Service Unit. Use of ATS-1 continues, pending installation of an operational satellite system. Each of the participating health aides has a "satellite radio" in his or her home connected by wire to the nearby ground station. Every day the doctor at Tanana calls each health aide in turn on the single "party-line" circuit. The aide may ask the doctor for specific instructions after describing signs and symptoms, or may simply seek verification of her own diagnosis and treatment plan. The medical facilities in the village are still very limited, so that seriously ill patients must be evacuated. The satellite radio can be used to arrange for evacuation of patients, usually to the Tanana Hospital.

An evaluation of the satellite "Doctor Call" was carried out by Stanford University under contract with the Lister Hill National Center for Biomedical Communication of the National Library of Medicine (Kreimer et al., 1974).

With the introduction of ATS-1, the communication picture changed dramatically in villages with ATS-1 ground stations. As is shown in Table 1-1, taken from the ATS-1 final evaluation report, the average number of days on which the health aides in satellite villages contacted a doctor increased more than five-fold in the first year of satellite use, and increased an additional 9% in the second year (Kreimer et al., 1974).

TABLE 1-1

Days of Radio Contact with Doctor Before and After Installation of ATS-1 Satellite Ground Station

| Villages | BEFORE | | AFTER | | | |
|---|---|---|---|---|---|---|
| | 1970-1971 | | 1971-1972 | | 1972-1973* | |
| | average number of days | % of poss. days | average number of days | % of poss. days | average number of days | % of poss. days |
| Experimental villages (9) | 51.7 | 14.0 | 270.2 | 74.0 | 310.0 | 85.0 |
| Control villages (4) | 44.0 | 12.0 | 24.3 | 7.0 | N/A** | N/A** |

SOURCE: Kreimer _et_ _al_., 1974.

*10-1-72/9-30-73

**Three of these four villages (Beaver, Hughes, and Koyukuk) had satellite radios installed in mid-April 1973. The fourth, Rampart, continued operation with HF radio, but no record of contact appears in the Tanana Hospital log.

Of greater significance, increased frequency of communication with the doctor meant that more cases could be treated with a doctor's advice. The number of new episodes for which the health aide consulted with a doctor more than tripled in the first year and continued to increase in the second year, as shown in Table 1-2 (also taken from the ATS-1 final report).

Health aides interviewed stated that daily communication with a doctor was important to them; the doctor's back-up boosted their own confidence and helped them to persuade patients to follow their advice. Frequency of radio contact among aides was much higher in satellite than in non-satellite villages, and appeared to be important both for morale and for continued learning. Health aides in six of the nine original satellite villages could cite specific examples of information or techniques they had learned over the radio, whereas none of the aides in the non-satellite villages could think of anything they had learned.

The party-line nature of the satellite radio channel was a mixed blessing. Private discussions between an aide and a doctor were impossible. On the other hand, aides picked up pointers by listening to discussions between doctors and other aides.

The evidence on the possibility of substituting communication for transportation was not definitive. Hospitalization rates did not differ significantly between satellite and non-satellite villages.

1.1.5.4 Operational Satellite Service

In 1975 the State of Alaska purchased 100 small satellite ground stations to provide telephone service and emergency medical communication for Alaskan villages. Initially they will have two audio channels, one of which will be used by the Public Health Service for medical communication.

The cost of a complete satellite ground station assembled from separate components chosen by the State was approximately $37,000 each in 100-unit quantities, excluding installation costs which vary from site to site. Three additional voice channels can

TABLE 1-2

New Episodes Handled by Teleconsultation

| Villages | BEFORE ATS-1 SATELLITE | AFTER ATS-1 SATELLITE | |
|---|---|---|---|
| | 1970-1971 | 1st year after (1971-1972) | 2nd year after (1972-1973) |
| 9 satellite villages | 47.1 (330)* | 184.6 (1,291)* | 290.0 (2,021)* |
| 4 HF radio villages | 24.7 (286)* | 15.0 (173)* | N/A |

SOURCE: Kreimer et al., 1974.

*Episodes per 1,000 inhabitants.



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be added for an incremental cost of $5,000 for the first and $3,300 each for the next two (Davis, 1975).

RCA Alascom has agreed to install and operate the 100 ground stations and has received Federal Communications Commission authority to do so. The eventual ownership arrangements will be determined by negotiations between the State and RCA, subject to regulatory approval.

These stations will provide audio communication only, which is widely recognized as the first priority for village service. However, the State is now (in 1976) examining options for providing television distribution and other telecommunication services such as data links and video distribution for education and health use. The ATS-6 demonstrations provided some of the knowledge and experience required for this planning.

The Lister Hill National Center for Biomedical Communication should be given major credit for these current advances in operational communication capability in Alaska. The ATS-1 project in medical communication provided a highly visible, highly acclaimed demonstration of technical feasibility and social benefit. A technical demonstration of a small ground station of the type eventually selected for use in Alaska was made at Point Reyes, California, in February 1974. Financed by the Lister Hill Center's ATS-1 evaluation contractor, this demonstration of economic and technical feasibility with an operational satellite provided the momentum that led to the installation of State-owned ground stations.

The first 20 stations are expected to come into service in March 1976, and an additional 40 are planned for operational service later in 1976. The remaining 40 should be installed during the 1977 summer construction season.

## 1.2 THE ATS-6 DEMONSTRATION

In order to gain a more thorough understanding of the potential applications and benefits of communication in village health

care, the Indian Health Service and the Lister Hill National Center for Biomedical Communication of the National Library of Medicine sponsored a further demonstration of NASA's ATS-6 experimental satellite in 1974 and 1975.

ATS-6 had the capability for transmission of video as well as audio signals. The availability of ATS-6 provided an opportunity to explore the application of video teleconsultation between primary providers with various levels of training, general practitioners in field hospitals, and specialists in Anchorage.

1.2.1 The ATS-6 Sites

In the ATS-1 project, the emphasis was on the communication needs of health aides in the villages. For the ATS-6 experiment, five sites were selected for participation to represent the various health care environments found in the Alaska PHS system, namely village clinic, service unit hospital, city clinic, and state medical center (see Figure 1). The personnel involved also represented the various levels of training found in the system: health aide, nurse, physician's assistant, general practitioner, and specialist (see Table 1-3).

The field sites selected were in the Tanana Service Unit in order to build upon the experience of the ATS-1 experiments, to include ATS-1 data as baseline data for the ATS-6 experiment, and to draw upon ATS-1 for back-up communication.

Unlike most service units, the hospital is not located in the main population center (Fairbanks). The 26-bed service unit hospital served by three doctors and supporting staff is in Tanana. Once a major trading center at the junction of the Tanana and Yukon rivers, Tanana's population has dwindled, and government agencies such as the PHS and the FAA are the major sources of employment.

The major commercial center for the region is Fairbanks, which grew rapidly during the planning and operational phase of the ATS-6 experiment because of its significance as a staging point for the Alaska pipeline. The Fairbanks Native Clinic, staffed by one M.D. during the period of this project, serves primarily the native population of Fairbanks and draws upon the specialists and hospital facilities in and near Fairbanks.

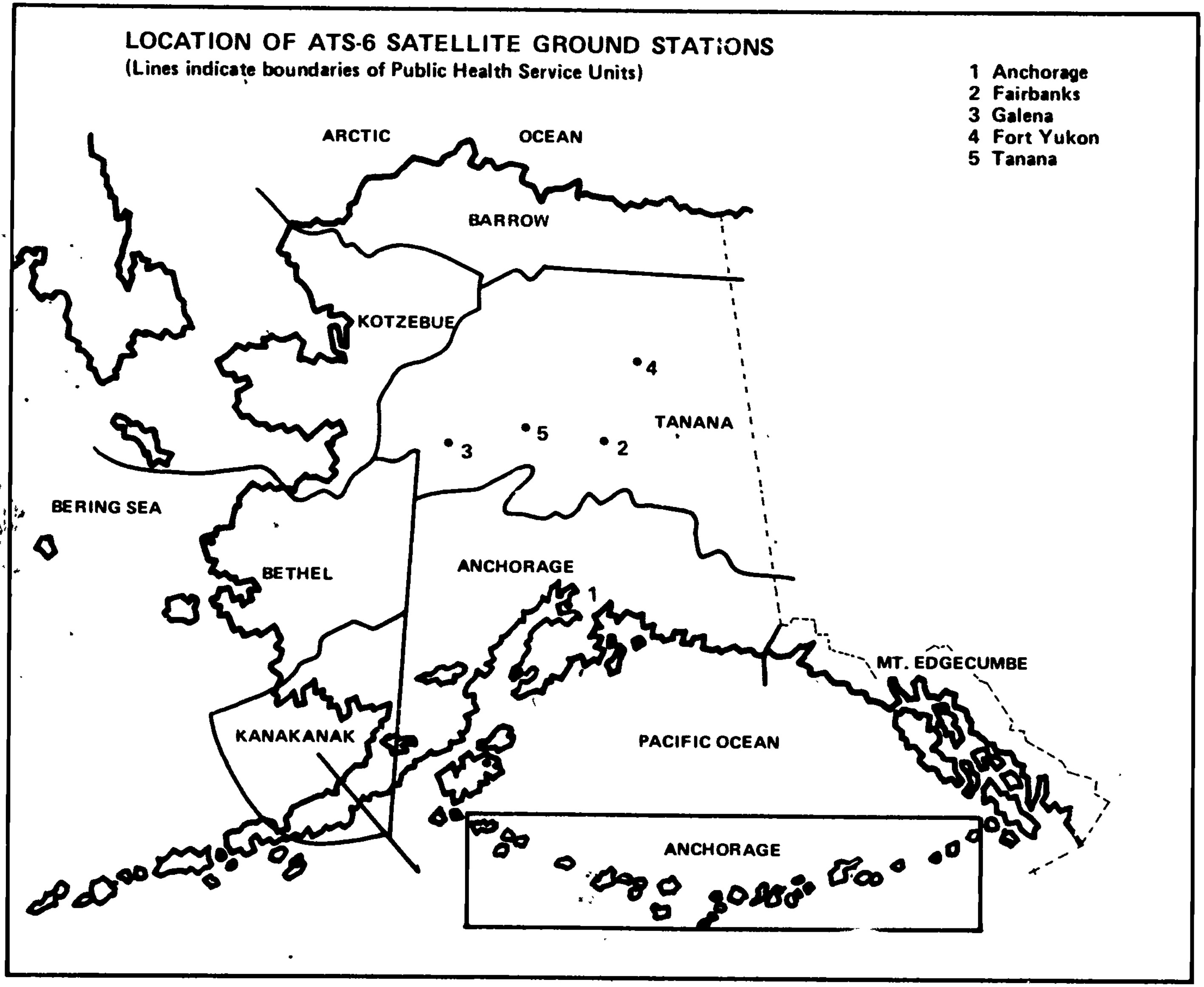

LOCATION OF ATS-6 SATELLITE GROUND STATIONS
(Lines indicate boundaries of Public Health Service Units)
1 Anchorage
2 Fairbanks
3 Galena
4 Fort Yukon
5 Tanana
ARCTIC
OCEAN
BARROW
KOTZEBUE
TANANA
BERING SEA
BETHEL
ANCHORAGE
MT. EDGECUMBE
KANAKANAK
PACIFIC OCEAN
ANCHORAGE

Figure 1

TABLE 1-3

ATS-6 Alaska Teleconsultation Demonstration: Sites and Facilities

| Location | Facility | Personnel | ATS-6 Capabilities | | |
|---|---|---|---|---|---|
| | | | Video | Audio | Other |
| Anchorage | Alaska Native Medical Center | Specialists, project staff | Receive only | 2-way | Stethophone, EKG |
| Fairbanks | Fairbanks Native Clinic | M.D., nurses | Switched 2-way | 2-way | Stethophone, EKG |
| Tanana | Service Unit Hospital | M.D.s, coordinator | Switched 2-way | 2-way | Stethophone, EKG |
| Fort Yukon | PHS Clinic | Nurse (R.N.) | Switched 2-way | 2-way | Stethophone, EKG |
| Galena | Village Clinic | Health aide, nurse (PHN), medex | Switched 2-way | 2-way | Stethophone, EKG |

Village patients requiring routine hospital care are generally sent to Tanana.

Because of personnel shortages, the M.D. at Fairbanks found that he had no time to participate in the ATS-6 demonstration. The Fairbanks equipment was eventually "cannibalized" to provide spare parts for other sites.

Health care for Fort Yukon is provided by a registered nurse who operates a PHS clinic. The clinic, which includes an examining room, X-ray development facilities, and living quarters for the nurse, is located in a two-story log building which was once a small church-run boarding school.

It was originally thought that the Galena clinic would be staffed only by a health aide during the project period. However, in addition to the health aide, Galena also had a physician's extender ("medex") hired by the community and a state-employed public health nurse, all of whom operated out of a one-room log cabin clinic which had no running water. (Galena also has U.S. Air Force medical personnel located at the Galena Air Force Base.) The staff planned to move to the recently constructed clinic at the new Galena townsite in the fall of 1974. However, this move was delayed until August 1975.

Occasionally, the Huslia health aide and the aides from Nulato presented patients over ATS-6 from Galena.

The four ATS-6 sites all have local exchanges connected to the State long distance telephone system in addition to the ATS-1 satellite radios which link them to the Tanana Hospital and other ATS-1 sites.

These sites are also well connected by regional air services. There are several daily flights between Fairbanks and Fort Yukon, and daily flights from Fairbanks to Tanana and Galena. (Patients traveling from Fort Yukon to the Tanana Hospital must change planes in Fairbanks.)

1.2.1.1 ATS-6 Facilities

Each field site had two ten-foot ground stations for the reception and transmission of ATS-6 audio and video signals.

Equipment installed for the experiment included a television camera, television monitor, microphones, a stethophone for transmission of heart sounds, and a remote EKG device for transmission of EKG tracings.

Each site also had a videocassette recorder to record consultations for later replay. This feature was used extensively by Anchorage staff to get opinions from specialists who were not available during the scheduled satellite periods. The specialist would view the tape at a convenient time and then consult with the provider at the field site by telephone. A schematic diagram of a satellite consultation is presented in Figure 2.

The video cassette recorders were also used occasionally in the field to record health education programs (originated from Tanana or sent by mail from Anchorage). This material could then be discussed over the satellite.

As space at each site was limited, equipment was generally placed in rooms used for other purposes. In Fort Yukon and Galena, the equipment was installed in the examination room. The equipment at the Tanana Hospital was placed in the radio room, which also houses the ATS-1 satellite radio. At Anchorage, the equipment was in a small "satellite room" where the ATS-1 radio was also located. At the Fairbanks Native Clinic, the ATS-6 gear was placed in a small separate room of its own.

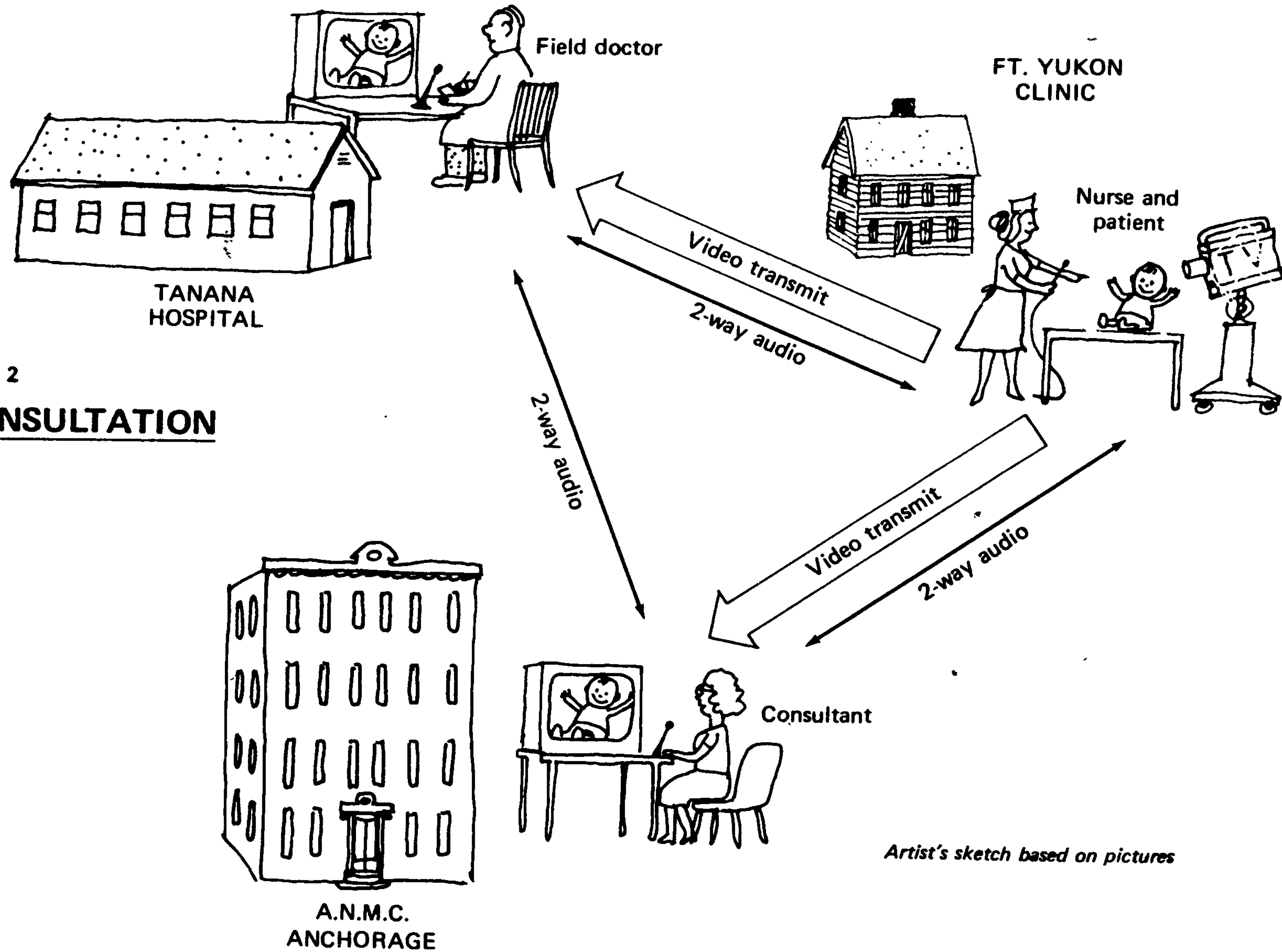
Video scramblers were provided at each video transmission site to prevent recognized pictures from being received on other ATS-6 television sets (e.g., those used in the education project). When the scramblers were used, only the ATS-6 biomedical sites, which had descramblers, were able to receive a clear picture.

1.2.1.2 Use of the Satellite

Three hours per week were available on ATS-6 for the Alaska biomedical demonstration. This time was divided into one hour periods at 11:30 a.m. on Mondays, Wednesdays, and Fridays. The project staff used the ATS-1 audio channel to contact the sites in the morning before the ATS-6 period to find out details of the cases

Figure 2

## A TYPICAL CONSULTATION




*Artist's sketch based on pictures*

to be presented. Typically, Ms. Cindy Britton, the coordinator at Tanana, would contact the health providers at each site about the day's cases, consult with Anchorage to request that appropriate specialists be available if necessary, and pull the patients' records at Tanana.

For teleconsultations, the television camera at the remote site was used to transmit a picture of the patient or of X-rays to the doctors. The cameras could be remotely controlled from Tanana and Anchorage, allowing the doctor to select and focus on specific areas. The video enabled the doctors to do close-up examinations (e.g., of lesions or eyes), to administer and observe tests (e.g., range of motion), and to judge the general well-being of the patient.

The video capability was also used frequently to transmit X-ray pictures so that paraprofessionals could get the advice of an M.D. or specialist. EKG tracings could be sent over the audio channel, and occasionally pictures of a locally made EKG were shown instead. Stethophones were supplied for transmission of heart sounds, but the providers were unable to get them to function properly (see discussion in Chapter 4).

Generally, cases were presented from the village clinics in Fort Yukon and Galena to the doctor in Tanana. Specialists, when requested, would monitor the picture in Anchorage and provide audio consultations. The system was also used by the Tanana physicians to present unusual or complicated cases to the specialists in Anchorage.

Approximately 300 cases were presented for teleconsultation over ATS-6 during the nine-month period. On the average, a consultation for a patient from a remote site took about 12 minutes, with preparation time about three minutes per case.

1.2.1.3 The Computerized Patient Record System (HIS)

Another element of the demonstration was the simultaneous introduction of a computerized patient record system called the Health Information System (HIS). Patient records in the Tanana

Service Unit were converted to a problem-oriented format and coded and key-taped at ANMC. Records are stored on disc and tape at a computer facility in Tucson, Arizona.

New HIS forms were introduced at the ATS-6 sites for patient encounters and consultations (by satellite, phone, mail, etc.). The provider filled out one form following the problem-oriented format. All the required information could be written on one sheet with three NCR paper copies, eliminating the need for multiple forms and records. One copy was kept for the patient's file and a second was sent to Anchorage for coding. A third copy could be used for special purposes.

A simplified version of the patient encounter form was designed for health aides and field-tested in Huslia and Venetie.

It was planned that the ATS-6 sites would have on-line access by satellite to the Tucson computer. However, that part of the demonstration encountered technical interface problems, and was not implemented until the very end of the demonstration. The providers at the ATS-6 sites had sets of the patient record summaries available on microfiche. A microfiche reader was supplied to each site. Updates of the records were sent out on microfiche every two weeks. Hard copy print-outs of the records were also available.

Providers were able to order problem summaries for use on field visits. For example, computerized summaries could be requested that listed, by village, all patients who had not had certain injections or pap smears, or had their eyes tested within a prescribed time period. Tanana could then notify the village health aides to have these people available for the doctor's visit.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 INTRODUCTION

The use of communication technology in support of health care is quite common. Imagine, for example, the chaos that would result if a modern hospital were suddenly deprived of telephone and paging services. During the last decade, however, some emerging uses of communications media in health care have been attracting considerable attention. These uses have come to be called "telemedicine," and include such varied activities as direct physician-patient interaction via two-way television, supervision of pharmacist assistants, systematic programs of medical consultation, telemetry of vital signs or chest sounds, psychiatric interviews, transmission of X-rays, and administration or management activities.

### 2.1.1 Definition

Some authors have attempted to develop definitions of telemedicine that would help distinguish between activities that were a part of this "exciting new phenomenon" and activities that were merely humdrum daily uses of communications in medicine. The results have not been conclusive. A few writers want to restrict the term to uses involving television. Dr. Kenneth Bird, an early implementer of telemedicine, suggests defining it as "the practice of medicine via interactive television" (Bird, 1975). Ben Park, author of a comprehensive overview of interactive television in health care, wants the term limited to that medium, although he is willing to admit a wider variety of health care activities (Park, 1974). Maxine Rockoff proposes a functional taxonomy of ways in which two-way video communications can be used in health care, including consultations, supervision, direct patient care,



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administration and management, and education and training, but she restricts the application of the word "telemedicine" to the direct patient care category (Rockoff, 1975a).

Other writers argue that the essential feature is the use of any communications medium to accomplish some medical task that would otherwise have to be done face-to-face. Rashid Bashshur, co-editor of a significant survey of the field of telemedicine, names "geographic separation" and "use of telecommunication equipment" as the first and second characteristics in a list of parameters of telemedicine (Bashshur, 1975). Dr. Allen Shinn, who has been involved in funding several telemedicine projects through his work at the National Science Foundation, takes a similar tack, requiring only that the activity use telecommunication, involve health care professionals, and have some health care delivery goals (Shinn, 1975).

For the purpose of this report, Shinn's definition is more appropriate. For one thing, many of the interesting projects rely on or incorporate non-video telecommunication. There is a growing interest in the use of narrower bandwidths, such as telephone lines, to provide at a lower cost some of the same functions television has effectively served. There is also an advantage in generalizability of a definition that rests on the characteristics of the medical activity, rather than on the medium of communication used.

### 2.1.2 Development of Telemedicine

According to one history, the development of telemedicine occurred in three stages (Bashshur and Armstrong, 1975). In the first stage, prior to 1969, there was experimentation in the clinical applications of telecommunication but little cohesiveness or organization in the effort. During this phase it was conclusively demonstrated that a wide variety of clinical tasks could be successfully accomplished via video.

The second stage, lasting from 1969 to 1973, saw strong trends toward government sponsorship of research and demonstration

programs in telemedicine, and toward better communication among the participants. Attention began to shift from questions of what could be done to how best to accomplish tasks. Evaluations began during this period, and attention started to focus on questions of organization, personnel requirements, and comparison of various media alternatives.

The third stage, since 1973, has witnessed greatly expanded and more sharply focused activities, and a growing concern for how to make telemedicine economically self-supporting.

2.1.3 <u>Specific Telemedicine Projects</u>

The reasons for implementing an operational telemedicine system can be divided into three major categories: improvement of access to a health care system, improvement of the capabilities of the system, and improvement of the efficiency of the system. Each of these categories subsumes many reasons given by project managers. For example, project goals that are expressed as "alleviating the uneven distribution of health care providers," "overcoming geographic or social distance barriers to entry into the health care system," and "overcoming a manpower shortage" all refer to increasing access to the health care system.

Similarly, goals such as "making specialist services available," "support for paramedical personnel through medical consultations," and "provision of continuing professional education" represent improvements in the capability of a health care system. Often the differences between improving access and improving capability depend on one's point of view -- making specialist consultations conveniently available to a general practitioner in a remote area either improves his capabilities or improves the access of his patients to sophisticated care.

Finally, some project goals, such as "decreasing travel," "avoiding unnecessary referrals," "improving the administration of an activity," and "reducing unit costs" fall into the category of increasing the efficiency of the system.

In addition to these types of goals, telemedicine projects have also often included research goals, such as comparing television and telephone consultations, or, more commonly, "exploring the feasibility of doing 'X' via interactive television."

A very diverse set of projects has been undertaken in attempts to achieve these goals. The projects will not be described in detail here; a number of excellent sources already exist (Bashshur et al., 1975; O'Neill et al., 1975; and Park, 1974). Rather, this section will present capsule descriptions of the major U.S. telemedicine projects in tabular form, in order to demonstrate the range of activities attempted or demonstrated. Table 2-1 presents the names, locations, communications media used, major activities, personnel involved, and population served in 24 major projects.

The distribution of these projects gives some insight into the way telemedicine is being applied. One third (33%) of the projects concentrate on delivering health care in rural areas. One quarter (25%) of the projects take place in an institutional setting, such as a hospital, nursing home, or prison. About one fifth (21%) are in urban environments, usually in inner city contexts. Another fifth (21%) cover several environments or cannot be classified into these groups.

Fully half of the projects have as a primary role the support of a non-physician health care provider through consulting and direct patient care. Providers range from auxiliaries with only a few months training through nurse anesthetists, pharmacists' assistants, physicians' assistants, and nurse practitioners. They generally operate quite independently and rely on the telemedicine support for help when needed. The major focus of 42% of the projects is the support of a physician, usually by specialist consultation. A few projects (8%) either support both physician and non-physician providers equally, or cannot be classified.

Only three (13%) of the projects use no television at all. The rest use television in one form or another, often in

TABLE 2-1

Telemedicine Projects

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| Medical Information System by Telephone (MIST) | Birmingham, Alabama | Telephones | Phone consultations with medical school specialists available to all Alabama physicians | Physicians | Residents of Alabama |
| Indian Health Service Community Health Aide Program | State of Alaska | High-frequency radio, ATS-1 satellite radio | Daily consultation in support of comprehensive health care | Community Health Aides, physicians | Indians and Eskimos in rural Alaska |
| Alaska ATS-6 Health Care Delivery Demonstration | Tanana Service Unit, Alaska | Black & white satellite television transmitted EKG electronic stethophone, data transmission | Consultation in support of comprehensive health care | Community Health Aides, nurses, physicians' assistant, physicians | Indians and Eskimos in the Tanana Service Unit |
| Veterans Administration ATS-6 Health Care Experiment in Appalachia | Ten hospitals in Appalachia, Denver, Colorado | Black & white and color satellite television, slow-scan television | Teleconsultations, video seminars, grand rounds, outpatient clinics, medical education | Physicians, nurses | Veterans Administration hospital patients |

TABLE 2-1 (continued)

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) | Tucson, Arizona | Black & white microwave television, slow-scan television, data transmission, mobile van clinic | Consultation in support of comprehensive health care | Nurse-practitioners | Papago Indians living on the reservation |
| Evaluation of the Impact of Communications Technology and Improved Medical Protocol on Health Care Delivery in Penal Institutions | Dade County, Florida | Black & white microwave and cable television, transmitted EKG, stethophone, facsimile transmission | Consultation in support of comprehensive health care | Nurse-practitioners, registered nurses | Inmates of Dade County prisons |
| Jacksonville, Florida Telemedicine Network | Jacksonville, Florida | Black & white microwave television | Medical consultation, direct patient care | Unknown | Residents of surrounding county |
| Videophone and Cable for Visual Communication and Transmission of Medical Records | Chicago, Illinois (Bethany Brethren and Garfield Park hospitals) | Videophone black & white cable television | 40% administration; 30% primary patient care; 20% medical consultation; 10% continuing education | Physicians | Urban poor |

TABLE 2-1 (continued)

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| Cook County Hospital, Department of Urology, Videophone Project | Chicago, Illinois (Cook County Hospital) | Videophones with remotely controlled cameras | 50% primary patient care; 20% administration; 15% continuing education; 10% medical consultation; 5% patient education | Nurses, physicians | Urban poor |
| Videophone Network of the Illinois Department of Mental Health | Chicago, Illinois (Illinois Institutes of Mental Health | Videophones with remotely controlled cameras | Psychiatric care | Physicians, registered nurses, psychologists, social workers, therapists | Urban poor |
| Blue Hill-Deer Isle Interactive Television Project | Blue Hill, Maine | Black & white microwave television with remotely controlled cameras | 50% primary patient care; 35% medical consultation; 10% administration; 5% medical education | Nurse-practitioner | Rural isolates, mostly poor |

TABLE 2-1 (continued)

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| Rural Health Associates | Farmington, Maine | Black & white microwave television | 40% administration; 30% medical consultations; 20% medical education; 10% direct patient care | Nurse-practitioners, physicians' assistant | Population of Franklin County, mostly rural |
| Nursing Home Telemedicine Project | Boston, Massachusetts (Boston City Hospital) | Telephones, transmitted EKGs, facsimile | Comprehensive geriatric care | Nurse-practitioners, internist | Nursing home patients |
| Massachusetts General Hospital Telemedicine Project | Boston, Massachusetts (Bedford VA Hospital, Logan Airport) | Black & white microwave television with image enhancement, stethophone, remote camera control | Medical and psychiatric consultation, direct patient care, medical education | Nurse-clinicians, physicians | Airport workers and travellers, patients at VA hospital |
| Cambridge Telemedicine Project | Cambridge, Massachusetts (Cambridge Hospital) | Black & white television, telephones | Medical consultations in support of comprehensive health care | Nurse-practitioners | Adult population of Cambridge |

TABLE 2-1 (continued)

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| An Experiment in Bi-directional Cable to Support a Rural Group Practice | Waconia, Minnesota (Lakeview Clinic) | Black & white cable television | 65% patient care; 25% medical consultation; 10% administration | Physicians | Rural population |
| Nebraska Veterans Administration Network | Omaha, Nebraska (and other VA hospitals) | Black & white and color television | 68% education; 25% patient care; 7% administration | Physicians | Veterans Administration patients |
| The Evaluation of Radiographic Image Transmission by Slow-scan | Omaha, Nebraska (Department of Radiology) | Black & white slow-scan television | Radiology only, 93% patient care & medical consultation; 7% medical education | Physicians | Patients at hospital in remote location |
| New Hampshire/ Vermont Medical Interactive Television Network (INTERACT) | Hanover, New Hampshire | Black & white and color microwave television | 62% medical education; 23% medical consults; 10% patient care; 5% administration | Physicians' assistants, physicians | Referrals |
| Wagner Bi-directional Cable Link Project | New York, New York | Black & white cable television with remote control cameras | Pediatrics only, 57% patient care & medical consultations; 38% administration; 5% specialized teleconsults | Nurse-practitioners | Preschool children |

TABLE 2-1 (continued)

| PROJECT | LOCATION | MEDIA | MAJOR USES | PERSONNEL | POPULATION SERVED |
|---|---|---|---|---|---|
| Case Western Reserve, University Telemedicine Program | Cleveland, Ohio (Department of Anesthesiology) | Color television transmitted by lasar, stethophone transmitting EKG, remote control camera | Anesthesiology only | Nurse, anesthetists, anesthesiologists | Operating room patients |
| Ohio Valley Medical Microwave Television System | Columbus, Ohio (and other hospitals) | Color microwave television | Medical consultations | Nurses, physicians | Residents of Ohio's area in Appalachia |
| Puerto Rico Telemedicine Program | Ponce District, Puerto Rico | Black & white microwave television with remotely controlled cameras, transmitting EKG | Emergency care, general patient care, medical consultation, medical education | Unknown | Low-income Puerto Ricans |
| Washington-Alaska-Montana-Idaho Regional Medical School Program | Seattle and Omak, Washington; Fairbanks, Alaska | Color satellite television, data transmission | Primarily education | Physicians, medical students | Patients at Fairbanks and Omak |

conjunction with some other medium. Use of black and white motion video is reported in 63% of the projects; 25% of the projects use color motion video. The use of color or black and white slow-scan video (i.e., still pictures on a television screen, transmitted over an audio bandwidth channel) is reported in 13% of the projects. Videophone is used in 13% of the projects, and audio-only communication (via telephone or radio) is a more than incidental component of 17% of the projects. One quarter of the projects (25%) make use of special diagnostic equipment in telemedicine, and 13% of the projects use data transmission, usually for medical records.

## 2.2 LESSONS LEARNED FROM TELEMEDICINE EXPERIMENTATION

Even though, as Bashshur and Armstrong point out in their history of telemedicine, the emergence of rigorous evaluations is a recent phenomenon, there are still numerous lessons to be learned from the experience with telemedicine to date (Bashshur and Armstrong, 1975). Many of these lessons are subjective or anecdotal; nonetheless, they offer a rich source of information for the student of telemedicine.

### 2.2.1 Feasibility of Diagnosis and Treatment by Telemedicine

A *sine qua non* of telemedicine is obviously the ability to conduct a wide variety of medical tasks successfully over the telemedicine system. By all accounts, practically anything that can be done in person can be done over video, at least as long as there is some trained health care professional (not necessarily a physician) at the remote site with the patient. Parts of this section will describe research on accuracy of diagnosis and on experience with specific diagnostic categories.

#### 2.2.1.1 General Diagnosis

It is revealing that most of the projects have simply taken it for granted that consultation or patient care via telemedicine is possible. These projects concentrate on questions of acceptability or possible savings in time and travel through the use of telemedicine. There have been, however, a few systematic studies

of the feasibility of telediagnosis, and there are many testimonial reports from persons involved in telemedicine projects. The general consensus has been very favorable to the feasibility of telediagnosis.

A major study was conducted of the first 1000 patients to be seen at the Logan Airport remote station of the Massachusetts General Hospital (Murphy and Bird, 1974). The first 200 patients to be "seen" over the video link were also examined in person by a physician at the medical station on the same day. In 96% of the cases, the "in-person" physician concluded that the "television" physician had made a proper disposition of the case. Only 1% of the cases were judged to have produced diagnoses that were "not satisfactory." The authors of this study suggest that these levels of agreement are actually very high when the usual levels of inter-observer reliability in medical diagnosis are taken into account. Of the subsequent 800 consultations, the telemedicine physician ranked 2% as not feasible for the current state of telemedicine.

A comparison of diagnostic accuracy for a wide range of medical problems was made for several different modes of interaction in another study (Conrath _et al_., 1975). They compared in-person performance with color and black and white television, and with a "hands-free" telephone in a well-designed experiment. The study classified diagnoses into "presenting diagnoses" (those related to the patient's presenting complaint), "critical diagnoses" (diagnoses that must be made if the patient is to receive appropriate care at that visit, even if unrelated to the presenting complaint), and "other diagnoses" (those that are neither critical to proper patient management or relevant to the presenting symptoms). They found no significant difference between any of the consultation modes for either critical or presenting diagnoses. Physical presence shows a marked superiority over other modes in revealing "other diagnoses." The other modes are all approximately equal in success at revealing "other diagnoses."

Studies of diagnostic accuracy in medical specialties are much more common, and often provide valuable insights into the specific demands or limitations of applying telemedicine in that particular specialty. Two specialties in particular, dermatology and psychiatry, have attracted particular attention as being the greatest challenges for telemedicine systems.

2.2.1.2 Dermatology

A study of diagnostic accuracy in dermatology is reported in Murphy and Bird (1974). This study compared diagnoses made of dermatological complaints when presented as projected slides and on black and white television. Participating dermatologists viewed the slides, first on black and white television and then projected in color on a screen. Black and white television diagnosis was less accurate than direct viewing in six out of a total of 141 valid trials. The television diagnosis was more accurate than direct viewing in four out of the 141 trials. In the remaining 131 cases the television and slide diagnoses were the same. There was no clear difference in accuracy of diagnosis between viewing of color slides and black and white television in this experiment.

In another experiment, these same slides were shown to internists who were not specially trained in dermatology, and the results compared to the success rates of the dermatologists (Murphy et al., 1972). The comparisons were made for direct viewing of the projected slides. None of the physicians were told anything about the medical history or the non-visual characteristics of the lesions, so the actual success rates are artificially low. The dermatologists correctly identified an average of 77% of the cases, while the internists correctly diagnosed an average of only 32% by the visual characteristics of the lesions. This evidence suggests that training and experience in a specialty may facilitate proper diagnoses when communication channel constraints limit the kind or amount of information obtainable.

Color is widely mentioned as an important diagnostic component in dermatolgoical consultations, yet most of the telemedicine

projects used black and white television.

One experiment directly compared the viewing of still pictures of dermatological lesions via color and black and white television (Murphy and Bird, 1974). The difference between black and white and color television diagnosis was quite small. Of a set of 54 slides of dermatological lesions, 42 were correctly diagnosed over black and white television. The use of color television led to correct diagnoses in an additional two cases. Nonetheless, physicians reported that the use of color made the diagnostic procedure faster and less frustrating.

Park reports a few informal findings about dermatology consultations (1974). A dermatologist who participated in the "Interact" program reported that lesions were generally easily discernible, and that color made diagnosis easier, faster, and less stressful than black and white -- but not necessarily more accurate. In another project, Park notes that dermatology diagnoses took less than half the time in color as in black and white.

Successful operational use of telemedicine for dermatology has been described in several projects (e.g., Bird, 1971; Siebert et al., 1972; Zinser, 1975). Siebert reports that in 24 consecutive cases checked in person immediately after a video diagnosis, "no additional useful information was obtained by direct examination of the patient by the consultant." In summarizing his project's experience with video diagnosis of dermatology cases, Bird asserts that "teledermatology has become a reality."

2.2.1.3 Psychiatry

Use of telemedicine for psychiatric diagnosis and therapy has become relatively common. The earliest reported study of video psychiatry was published in 1961 (Wittson et al., 1961). This paper compares group therapy sessions led in person with sessions led via television. The results of the study demonstrated that there was no difference between the TV and non-TV groups attributable to television in the ratings either by the patients in the group or by the therapist. The personality of the therapist did

have an influence on group ratings; the medium in which the sessions were conducted did not. A follow-up article on the same project reports continued success in psychiatric telemedicine and confirms the previous finding that use of television does not seem to influence the process of diagnosis or therapy (Wittson and Benschoter, 1972).

Interactive television had been used for consultation in psychiatry as well as direct patient care. One program has offered consultation and education to non-psychiatric health care personnel to assist them in dealing constructively with the mentally retarded (Menalasco and Osborne, 1970). It reports more positive attitudes toward the mentally retarded, better allocation of staff resources, and improvement in patient care through the use of this system.

Another consultation-oriented, as opposed to direct care-oriented, system was tried at the INTERACT project in New Hampshire (Solow et al., 1971). Consultation with psychiatrists was provided to non-psychiatrist physicians to improve their knowledge and understanding of psychiatry and to help them treat their emotionally disturbed patients. The users found that television "has not proved to be a significant barrier in establishing rapport with the patients or in perceiving emotional nuances."

Reports are available on two programs of psychiatric telemedicine conducted at Massachusetts General Hospital (Dwyer, 1970; Dwyer, 1973). The interactions included diagnostic interviews, treatment involving interviews or interviews plus drug therapy, intervention in acute crises, prolonged therapy for psychotics, counseling to students, and administrative uses. Both psychiatrists and patients seem satisfied that most psychiatric problems can be effectively handled via telemedicine. However, the implementation of these programs involved considerable frustration while the therapists and patients learned to work productively with the new medium (Bird, 1971).

2.2.1.4 Other Specialties

Successful uses of telemedicine in a variety of other

specialties have also been reported. Wheelden (1972) discussed the successful treatment of speech problems via interactive television. Television has been used for remote monitoring of nurse anesthetists in surgery by anesthesiologists (Gravenstein et al., 1974). Routine pediatrics care is provided via cable television in the Mount Sinai Project (Wallerstein et al., 1973). Many other uses are reported anecdotally in the literature.

2.2.2 Use of Diagnostic Equipment

The use of common diagnostic aids such as electrocardiograms, stethoscopes, and X-rays is an important part of medical care. Use of these devices or of functional equivalents must be accommodated if physical diagnosis and appropriate patient management are to be practical via telemedicine.

2.2.2.1 Radiology

Telemedicine has shown considerable promise in radiology. Interpretation of X-rays is a complex and subtle process, yet the users of telemedicine systems are virtually unanimous in saying that it can be accomplished satisfactorily via video. A series of studies made at Massachusetts General Hospital have been reported (Andrus and Bird, 1972a; Andrus and Bird, 1972b; Murphy et al., 1970). The earliest study compared diagnoses made by a panel of physicians "with particular interest in chest disease" after viewing chest X-rays on television, with the judgments made by the hospital radiologist after viewing the films directly. Subsequently the hospital radiologist viewed the films of video, and his in-person and video judgments were compared. Agreement was very high on all comparisons. The panel of physicians had a slight tendency to classify cases as more serious than they really were, but they were able to detect cases of minimal disease.

The two studies by Andrus and Bird report that videotaping of televised X-rays for later reading seems quite feasible, and that, in order to derive the most information from a televised X-ray, physicians must change the way they read the image. They must adopt a systematic scan pattern and use the camera's zoom lens to maximize the resolution in small portions of the film.

Steckel (1972) describes a different approach to solving the problem of limited resolution of the television picture. Rather than merely "zooming in" so that the lines of the TV picture display a smaller portion of the X-ray, with a consequent increase in resolution, his group employed a television system with 875 lines, and hence better initial resolution. He reports good results in the use of this system.

One project devoted entirely to radiology, the University of Nebraska Slow Scan Radiology Project, transmits still video pictures of X-rays via telephone lines for remote interpretation by a radiologist. No published reports of the project's results are available, but Park (1974) describes several complicated diagnoses that have been made successfully over the slow-scan channel. Other successful transmissions via slow-scan are described in the ATS-6 Veterans Administration Experiment (Applied Communication Research, Inc., 1976). This particular use holds considerable promise, because the cost of using telephone lines for transmission is much lower than the cost of transmitting at full video bandwidth.

Transmission of X-ray images via geostationary satellite has been used in one novel transaction prior to its implementation in Alaska. An INTELSAT satellite was used for transmission of voice, facsimile, and slow-scan video pictures of X-rays and slides between the hospital ship SS Hope, while visiting Brazil, and a hospital in Washington, D.C. The one-time experimental consultation concerned a patient with lymphosarcoma, and the X-rays were of sufficient quality to be medically useful (Riggs et al., 1974).

2.2.2.2 Auscultation

Many of the projects have incorporated the use of an electronic stethophone for transmission of heart and chest sounds during patient examinations. The trend of the results that have been reported is that tele-auscultation can successfully be done if the necessary, rather stringent technical requirements are met.



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For instance, in the Massachusetts General Hospital link with a remote clinic at an airport, the researchers report an improvement in ability when the clinic was moved further away from the runway and equipped with sound insulation. The experimenters conducted a study comparing in-person and tele-auscultation of heart murmurs. In their sample, all murmurs of grade 2/6 or higher were heard easily in both modes; two of the 30 grade 1/6 murmurs that were detected in the in-person mode were not detected by tele-auscultation. However, both of these errors occurred before the steps were taken to quiet the clinic's ambient noise (Murphy et al., 1973; Bird, 1972). Other projects and studies also indicate that tele-auscultation can be performed (Marshall and Wallerstein, 1973; Cooper, 1969; Vaules, 1970).

The Lakeview Clinic Project reported difficulties in using electronic stethophones (Wempner et al., 1974). The difficulties they encountered centered around "sounds that were foreign to the physician's ear" and that impeded his diagnostic activity. They were not able to determine whether these were caused by outside interference or were heart and respiratory sounds inaudible on an ordinary stethoscope.

Another unsuccessful attempt to transmit cardio-pulmonary sounds is reported by Hastings and Dick (1975). They found that "it was technically impossible to maintain a satisfactory background noise level using a telephone line link, and that the telephone line link could not be made to transmit sounds in the frequency range of 150 to 50 cycles per second, and these are the frequencies at which initial murmurs and extra heart sounds are heard."

#### 2.2.2.3 Electrocardiograms, Electroencephalograms, and other Diagnostic Aids

Electrocardiograms and, in some cases, electroencephalograms are routinely transmitted or displayed before a camera in a number of projects. There is little or no problem in doing this; Murphy and Bird (1974) report that their electrocardiographic transmis-

sions via microwave exhibit less than a two percent variation in magnitude of the recorded wave form. Satisfactory results are also found with telephone transmission of electrocardiograms (Holsinger and Kempner, 1972).

Other diagnostic uses, such as transmission of gamma scintigram pictures or radioisotope scans, have been suggested (Webber and Corbus, 1972).

### 2.2.3 Technical Issues

#### 2.2.3.1 Bandwidth and Various Media Alternatives

A television picture with sound requires roughly 2000 times the bandwidth needed for a telephone channel (Park, 1974). The difference in communication channel costs is one factor that influences the cost of the system. According to one report, "a rough rule of thumb for estimating the relative costs of various options [is that] facsimile techniques cost about ten times as much as a telephone and two-way TV costs about ten times as much as facsimile" (Willemain, 1975). Facsimile techniques are systems that send visual information over a telephone circuit, such as transmitted EKGs, slow-scan television, or wirephotos. This rule of thumb is very rough and is obviously heavily influenced by such factors as the peripheral equipment required, the number of stations that are to be equipped, and the distance that the signal must be sent. The cost of the communication system might be offset by savings in other areas, such as travel. Nonetheless, because there are obviously large cost differences implied by the choice of medium, it is important to ascertain the limitations that each may have.

In the telemedicine experimentation to date, a wide variety of media have been examined. These include black and white and color television, one-way and two-way television, picture phones, slow-scan television, facsimile transmission, and telephones. Color, black and white, one-way and two-way television fall into the wide-band category; all the others fall into the narrow-band group.

There have been several systematic, direct comparisons of different media. One study compared black and white television with telephone consultations between physicians and remote nurse practitioners to determine whether, if video consultation were available, there would be differences in productivity, referral patterns, and satisfaction (Moore et al., 1975). Nurses in remote clinics were assigned randomly each day to either the telephone or television group during the seven and one-half months of the study. Twenty-five percent of the visits to the remote clinics led to consultations; there was no difference in consultation rate for telephone and television days. The distributions of problems consulted on were almost identical. The median length of telephone consultations was three minutes, compared with five minutes for television consultations. The length of a patient visit that required consultation was 40 minutes on telephone days and 50 minutes on television days, due to a longer pre-consultation work-up and a longer delay after requesting consultation.

Equal proportions (about 30%) of telephone and video consultations resulted in referrals to doctors. However, television consultations were immediate referrals to hospital physicians only half as often as were telephone consultations, a result which suggests that physicians more often felt comfortable in delaying a referral when they had the opportunity to see the patient.

Patients were equally satisfied with telephone and television consultations. Less than 5% said they would have preferred to see the doctor in person, with no difference between television and telephone. Physicians and nurse practitioners were well satisfied with both telephone and television consults to about the same extent. Physicians preferred television only for consultations involving medical decision-making.

Another experiment compared color television, black and white television, hands-free telephone, and in-person examinations (Conrath et al., 1975). As reported in the section on general diagnosis, there were no significant differences among the

consultation modes in identifying presenting symptoms and critical ailments. Physical presence is better for identifying "other" non-critical ailments, while the rest of the modes are equal. The average time to complete the diagnostic process is essentially the same across all modes. Physicians felt that their ability to make a diagnosis was best in the physical presence mode and the same in the rest of the modes. Physician preferences were first for physical presence, second for either black and white or color television, and finally for hands-free telephone. Patients' attitudes were quite similar to the doctors', except that the patients held more positive attitudes toward the remote modes than did the doctors (Conrath _et al_., 1974).

A study that measured the attitudes of nurses and physicians participating in one telemedicine project compared telephone, slow-scan, and color and black and white television (Hastings and Dick, 1975). Nurses and doctors agreed that slow-scan television was no more useful than telephone, but that wide-band television was slightly more useful than telephone. Doctors had a slight preference for in-person examinations, and felt that color added little to their diagnostic capabilities.

A number of problems connected with use of videophones have been reported (O'Neill _et al_., 1975). The resolution of the image was often inadequate, and the size of the image was too small, for instance, to display an 8-1/2 by 11 inch page with enough clarity for reading. (Videophones have lower resolution quality than standard U.S. television signals, which are also unsatisfactory for text display.) Special adaptations to the equipment have eased, but not solved, these problems. Rockoff (1975a) also comments on the limitations encountered in the use of videophones. Several uses of the telephone for transmitting diagnostic information have already been mentioned (Vaules, 1970; Cooper, 1969; Webber and Corbus, 1972; and Holsinger and Kempner, 1972). A statewide telephone network for obtaining consultations and information from specialists is described in Klapper (1975).

2.2.3.2 The Role of Color

Assessments of the value of color are mixed. Some findings on the role played by color have already been reported. Murphy and Bird (1974) report a minimal improvement in diagnostic capability in dermatology that is attributable to color. They later note that "the lack of color ... can be offset by proper communication between the remote examiner and the nurse." Park (1974) advises caution in considering the question of color for telemedicine. He argues that "color television requires greater initial outlays of money, mandates greater maintenance expense, and has not shown sufficient additional utility to justify the difficulties and expense." Eastwood et al. (1975) describe considerable difficulties in obtaining color renditions that are clinically useful. However, Siebert et al. (1974) report that a color rendition "highly satisfactory to the consultant dermatologist" could be routinely achieved on high quality equipment, and that color made diagnosis easier, faster, and less stressful, although not necessarily more accurate. Rockoff (1975a) adds that color may increase the speed with which a diagnosis can be made.

2.2.3.3 Extra Video Features

Two features of cameras used in most of these projects have almost unanimously been judged necessities — zoom lenses and remote control. O'Neill (1974) describes the kinds of control required (pan, tilt, zoom, focus, and iris aperture) and notes some of the effects of each. Control over the direction of the camera improves the images available to the consultant and is especially valuable in reducing the frustration that arises when consultation participants try to adjust the camera or patient position, or give directions for that adjustment at the same time as they present a patient or try to absorb information about one. The zoom and iris aperture controls, in combination with the other controls, are particularly important in viewing X-rays. Rockoff (1975a) seconds these observations and suggests that full remote control of the camera may even compensate for some of the resolution problems inherent in television.

The ability to record transmitted teleconsultations is said to have some unique advantages. Bird (1971) suggests that, besides such obvious uses as educational programs, replaying particular segments to glean more information, or using the videotape to permit delayed consultations, the videotaping capability has important uses in providing feedback. He is particularly interested in using videotapes for physicians' self-assessment of their technique and self-presentation, and in therapy sessions to give patients feedback on their behavior. Rockoff (1975a) suggests that they could be used to provide "batch screenings" of different cases. For example, an orthopedist could view videotapes of cases to determine whether they needed to be seen in person. This would free him and the patient from the real-time constraints of live transmission.

2.2.3.4 Conference Capability

The ability to have more than two persons involved in a consultation and/or more than two locations linked together is sometimes cited as a desirable technical feature. Rockoff (1975a) stresses that the potential value of being able to conference in a third location is balanced by the threat to privacy that results. Two reports on the Alaska ATS-1 project describe tangible positive consequences of the fact that all stations hear each other all of the time (Hudson and Parker, 1973; Kreimer et al., 1974). The results of these studies indicate that the opportunity offered by the satellite network to listen to exchanges between the other community health aides and the doctor yielded benefits in morale and in continued learning. O'Neill (1975) provides indirect testimony of the value of conference capability when he faults the videophone system for its inability to handle more than one voice at a time. When two or more people spoke simultaneously, only the loudest voice was transmitted.

2.2.4 Social and Institutional Issues

The potential reliance of health care systems on telemedicine to support allied health personnel has profound and wide

ranging implications. Much has been written about the larger issues, which Park (1974) has identified as follows:

> How does the interactive television alter relationships among users?
>
> What is the impact of telemedicine on health and medical organization?
>
> How best can satisfactory access be provided?
>
> What should be the relationship of telemedicine facilities to larger telecommunication networks?
>
> What legal issues are involved?
>
> What payment issues are involved?
>
> How are factors of quality and access maximized relative to service requirements?
>
> At what point(s) can cost benefits of telemedicine facilities be meaningfully assessed?

The breadth of those issues far exceeds the scope of this review; rather, this section will focus on a few small but pertinent facets of these issues. For the reader who is interested in pursuing the larger issues, good places to start would be Bashshur, Armstrong and Youssef (1975), Park (1974), and Rockoff (1975b).

2.2.4.1 Administrative, Emergency, and Other Communication

Communication of administrative information, such as coordination of activities, record keeping, transportation, etc., has emerged as an important, if sometimes unexpected, portion of the telemedicine projects' transactions. In responses to a mail survey reported by Bashshur, Armstrong and Youssef (1975), three of nine projects for which data are reported devote approximately 40% of their communications to administrative matters. In writing about another project included in the mail survey, Bashshur and Armstrong (1975) assert that "one of the most effective uses [of television] was ward administration." In remote Alaskan villages lacking other means of communication, the community health aide averaged about 230 patient consultations and about 280 administrative items per year over the ATS-1 system. However, because

patient consultations took longer, 72% of the time was allocated to medical matters and 27% to administrative matters (Kreimer _et al._, 1974).

The ability of a telemedicine system to provide immediate expert help in emergency situations has been recognized as a particular asset. This characteristic has special value when allied health personnel are working autonomously in a remote location, but emergency interpretation of physiological or laboratory data by a specialist may be crucial even within a hospital situation. Bird (1971) reports several such situations at Massachusetts General Hospital. Hudson and Parker (1973) discuss an emergency case in which extreme inconvenience in conducting the teleconsult did not deter the health aide from completing it, so great was her need for a physician's help. Kreimer (1974) describes the use of the Alaska telemedicine system under more "normal" emergency conditions.

Telemedicine systems can also enable patients unable to visit their homes to communicate with their families. Bashshur and Armstrong (1975) report on the use of a television system to permit hospitalized psychiatric patients to keep in touch with their families in a distant city. Hudson and Parker (1973) describe how use of the ATS-1 telemedicine system in Alaska for direct and indirect patient-to-family contacts overcame the problem that once a patient left a remote village to get medical care, the family would hear nothing about him or her until he or she returned to the village. This uncertainty was an obvious source of psychological stress for the families.

2.2.4.2 Patients' Attitudes Toward Telemedicine

Questions about the acceptability of telemedicine systems to patients were major worries to the planners of most telemedicine systems. A somewhat surprising but very widely reported finding is that these fears were almost completely groundless. In a paper reviewing the technical and health care implications of several telemedicine projects, Rockoff (1975a) summarizes the



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result succinctly: "Patient acceptance, anticipated to be a problem, simply never was." In a discussion of psychiatric interviewing via television in a different project, Dwyer (1970) comments that " ... in some instances the patients were more comfortable talking to a psychiatrist by this means than meeting him in an office or clinic ...." O'Neill (1975) notes in his description of seven major telemedicine projects that " ... no appreciable patient dissatisfaction with telemedicine care was detected or registered."

A systematic study of patient attitudes toward telediagnosis was reported by Rule (1975). From a mail survey of patients seen on the Massachusetts General Hospital telemedicine system, he found that about 15% of the respondents were strongly critical of telediagnosis. However, there was no indication that their reservations were serious enough to lead them to refuse to participate or to oppose the use of telemedicine.

2.2.4.3 <u>Health Care Personnel Attitudes Toward Telemedicine</u>

The attitudes of health care providers toward the use of telemedicine are much more heterogeneous than those of the patients. This is not a surprising finding, because the roles these providers play and the costs and benefits they experience vary as a function of their tasks in the health care system. Because almost all projects have reported anecdotal information about acceptance, there is a vast amount of unorganized data. This section will confine itself to generalized findings and systematic studies.

Park (1970) summarizes a few of the more general findings. He observes that on the whole satisfaction outweights dissatisfaction, but cautions that this may be the result of a novelty effect. Then he notes that the bulk of telemedicine interactions, in systems where participation is by choice, are often accounted for by a small group of enthusiasts, while their colleagues remain skeptical and uninvolved. This fact makes it difficult to interpret the results of surveys of telemedicine users. A common

complaint about telemedicine is that it exposes the participants to review by specialists and colleagues, which seems to be especially threatening to solo practitioners.

O'Neill (1975) also comments on the "Big Brother is watching" syndrome as a source of irritation to telemedicine participants. He adds that frustrations arising from such apparently trivial concerns as location of the stations in the hospitals, layouts of the control panels, and set-up time can influence considerably health care provider attitudes toward telemedicine. He suggests that participation of staff in planning and careful training can minimize these problems.

A survey of health care providers who used the Miami-Dade County telemedicine system revealed a number of points of friction (Hastings and Dick, 1975). Nurses were less favorable to the system than doctors. Some of the specific complaints of the nurses were: the stethoscope was not effective; TV took too much time; maintenance problems made TV impractical; there was a lack of familiarity with the mechanics of TV; and more training would have been helpful.

Rogers and Pendleton (1975) report on a study of attitudes toward the Nursing Home Telemedicine program in Boston. They found that the majority of the respondents would prefer to keep the telemedicine program operating in their homes. As advantages to this, the respondents cited:

Improved medical care

Greater frequency and length of visits by nurse practitioners

Better accessibility to staff at the hospital

Improvement in staff morale

Thoroughness of the patient coverage

As disadvantages to the program, the respondents noted that:

There were problems with state regulations

There was no continuity of care for patients who were subsequently hospitalized

Dependence on the service gave the project too much leverage over the nursing home

The possibility that the telemedicine program might jeopardize the nursing home's relations with the community physicians

A pre-post survey of physicians is reported in Wempner et al. (1974). They interviewed people to be involved with the Lakeview Clinic project before the project started and 12 months after the implementation of telemedicine. Physicians expected the system to save travel time, increase care quality, reassure patients, enhance the patient-physician bond, encourage consultations, make reaching a consulting physician easier, increase the involvement of allied health workers in patient management, make lab reports and charts more available, and reduce patient waiting time. The "post" survey revealed that not all these expectations were realized. They felt that travel was saved, patients were reassured, patient-physician relations were enhanced, and it was easier to get physician consultations. However, they felt that the quality of care had not increased, costs had not been reduced, consultations had not been encouraged, involvement of allied health workers had not increased, charts and lab reports were not more readily available, and patient waiting time had not been reduced. They did report that telemedicine represented an improvement over telephone consultations.

## 2.3 SUMMARY

Telemedicine systems seem to be able to handle almost any type of complaint or condition. While there are obvious limitations to the systems regarding, for example, tactile or olfactory information, the experiments to date have been relatively successful in circumventing these limitations by using some level of trained medical person at the remote location. The possibility of delivery of medical care via television is firmly established.

The use of visual diagnostic aids, such as X-rays and electrocardiograms, is commonplace in telemedicine systems. As long as the television cameras are equipped with lenses that permit close-ups of portions of the X-ray and heart tracing, there appears to be no problem in using these techniques. Additionally, electrocardiograph output, when appropriately amplified, can be transmitted over narrow-band lines, such as telephone lines, to produce accurate hard-copy tracings remotely. The transmission of heart and chest sounds seems to be successful when very high standards of technical performance are met.

There are large cost differences between wide-band and narrow-band telemedicine systems. Experience and formal experimentation have shown only very minimal differences between the ability to perform most common medical tasks through in-person encounter, telephone, slow-scan, and full video consultations. Color seems to add little to diagnostic capabilities and, in some cases, may even be detrimental. Television consultations take longer than those by telephone, apparently for reasons unrelated to medical information seeking or processing. Some evidence indicates that health care providers prefer color video for telemedicine, for reasons "not based on efficiency or effectiveness factors" (Conrath et al., 1975), but other authors argue that color may make quicker diagnosis possible. Control of the camera by the consultant is essential to a smooth and productive consultation. Videotaping of consultations can provide some advantages in convenience and additional capability. Conference capability may offer some benefits in the areas of convenience, morale, and education.

Administrative communication via telemedicine can play a vital role in the efficient operation of the health care system. Provision of emergency consultations has been a valuable feature of some telemedicine systems, as has been communication between patients and their families in some cases.



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Patient attitudes toward telemedicine have been surprisingly positive and homogeneous. Provider attitudes, on the other hand, are mixed. Satisfaction seems to outweigh dissatisfaction, but there is a realistic perception of the limitations of telemedicine systems. Many of the complaints are about operational details, rather than being fundamental criticisms of telemedicine.

## CHAPTER THREE

## RESEARCH METHODOLOGY AND DATA SOURCES

### 3.1 RESEARCH DESIGN

The Alaska Health Care Delivery Demonstration is often miscalled an experiment. In a true experiment, many possible alternative explanations of observed changes can be ruled out because the research situation is rigidly structured and participants are randomly assigned. Neither of these conditions was met in this project. The communities involved were not typical of the population of communities from which they were drawn, particularly in terms of size, availability of transportation, communication, and health care services. Two quite distinct innovations were introduced -- the video teleconsultation and the Health Information System for record keeping. And organizational arrangements could not be controlled, since the organization had to be kept flexible to respond to changes in health care needs and temporary problems with equipment or personnel.

A better title for this project might be "field trial" or "exploratory demonstration" because fundamentally, the project goals were to explore the potential of video teleconsultation for health care in the Alaskan bush and because no possibility existed to hold the situation variables constant or to provide truly comparable control groups.

The best conceptual model for the evaluation is a quasi-experimental non-equivalent control group design with measures taken on the dependent variables in the presence and absence of the experimental treatment. Ideally, the measures would be taken before, during, and after the experimental treatment. Then differences for the same site at various times could be compared with parallel data in the non-equivalent controls, and differences between sites could also be compared at various times. This approach

provides some control over major threats to validity and hence interpretability.

Unfortunately, the ATS-6 telemedicine demonstration did not lend itself to the imposition of any one research design on the project structure. As indicated above, the sites involved were not representative of Alaska communities; assignment of sites to treatments was anything but random; the "experimental treatments" were not held constant; reasonable control groups were often not available; and baseline rates were difficult to establish. These structural difficulties were compounded by more operational impediments such as problems in securing permission or cooperation in collecting certain kinds of data, change-overs in record keeping systems, prolonged equipment failures, and personnel turnover.

Given these conditions, strict adherence to the idealized research design would not serve the evaluation well; a somewhat opportunistic approach was adopted with regard to comparison data, to permit the inclusion of a larger number of control or baseline measures. In the following chapters, comparative data will be presented where credible data exist for a reasonably comparable control group, or where multiple measures of the same variable were made as a safeguard against unreliability.

## 3.2 CONCEPTUAL STRUCTURE OF THE EVALUATION

The scope of the topics examined by the evaluation is quite broad, as is appropriate to an exploratory project. They can be divided into a small number of basic categories that can be seen as a conceptual classification scheme for dependent and descriptive variables. The categories are:

- -- Technical performance of the system
- -- Usage of the system
- -- Effects on the process of medical care
- -- Effects on the outcomes of medical care
- -- Changes in attitudes of the participants

A few sample questions representative of each topic area are given here to show the dimensions of each topic area or "dependent variable cluster." Needless to say, this evaluation does not attempt to answer all the questions presented here. A later section of this chapter describes the sources of data used to investigate these topic areas.

3.2.1 Technical Performance

Before evaluating the effects of video teleconsultation, it must be established that the system was available for use, was of high enough quality to be useful, and was used. Chapter 4 describes the findings on technical performance:

> How reliable was the equipment? Was the signal quality adequate to the medical tasks? What kinds of failures were encountered? How often did failures happen and how difficult were they to repair?

3.2.2 Usage of the System

Chapters 5 and 6 outline the findings on the amount and type of usage of the system:

> How much use did the system get? By whom? For what types of medical complaints? For what types of administrative and other matters? How often was the specialized diagnostic equipment used? In what villages do the patients live? How significant is proximity in determining who is served?

3.2.3 Effects on the Process of Medical Care

The introduction of an innovation like teleconsultation changes the medical care process whenever it is used. The evaluation must address the question of how the process changes and what the effects of these changes are. Chapter 7 presents the evidence on effects on the process of medical care:

> Does the innovation serve a different population? Is the distribution of diagnoses different? Is the efficiency of care changed? Are more or

> fewer patients served? How much time is lost to technicalities of operating the system? Is travel by patients or providers avoided or increased? What kinds of cases are most appropriate to the system? How do television consults differ from radio and in-person consults? To what degree and under what conditions are television and radio substitutable for one another? What impact does the innovation have? Do the consults lead to changes in the diagnoses or management plans?

### 3.2.4 Effects on the Outcomes of Medical Care

The ultimate goal of introducing innovations like this into the health care system is to affect the patients' level of health. Changes in the outcomes for the patients are discussed in Chapter 8:

> Are patients healthier? Are their episodes less frequent or less severe? Does the distribution of complaints change? Are patients more satisfied with their treatment? Do physicians feel that health outcomes have been improved?

### 3.2.5 Effects on Attitudes of Participants

Many of the changes accompanying the use of a satellite video consultation capability may be rather subtle attitudinal changes. The attitude domain of primary interest is the acceptance of the service by health care providers and by patients, but the changes may encompass a broader realm. Chapter 9 summarizes the attitudinal data for both providers and consumers:

> Is the system acceptable to the providers? Does it fit well with established patterns and institutions? Is it easy and rewarding to use? Is there a desire to continue or expand the program? What parts of the system are most and least useful? What effect has there been on professional self-confidence or morale?
>
> Is the system acceptable to the client? Does he feel that his dignity and privacy are adequately protected? Does he perceive that his health or the health care system has improved? Does he feel that the problems being addressed are high priority concerns of his?

## 3.3 SOURCES OF DATA

The data on all of these clusters of dependent variables come from many sources. There is generally not a one-to-one correspondence between a data source and a dependent variable or variables. The various data sources each reflect on several evaluation questions or issues. Most dependent variables are measured by several different instruments.

The data collection techniques range from use of archival data to keeping of log forms, use of structured interview techniques, attitude scale responses, and subjective observation. The use of multiple data collection methods and multiple measurements affords a certain measure of confidence in the results if the separate measures display similar patterns. This section will describe each of the major systematic data collection efforts undertaken for this project.

### 3.3.1 Health Information System Data

The Health Information System (HIS) is a computerized, problem-oriented outpatient medical records system that was originally developed for use on a Papago Indian reservation in Arizona. A version of the HIS was implemented in the Tanana Service Unit in Alaska as part of this demonstration. It became operational shortly before the video teleconsultation activities were begun, and operated relatively smoothly during the entire satellite portion of the demonstration.

Providers using HIS fill out an encounter form for each outpatient encounter in the Indian Health Service. In Alaska, three separate versions of the form were in use in encounters that were relevant to the evaluation. Doctors and nurses used one form for all outpatient encounters; the community health aides in Huslia and Venetie used a simplified version of this form. A teleconsultation form was completed by the consulting physician for every consultation, whether by ATS-6, ATS-1, phone, or mail. (Some cases were excepted when Tanana consulted with Anchorage. In those cases, the Anchorage physicians would have

filled out the teleconsult form, if they had been participating in HIS. Unfortunately, because Anchorage was not using HIS, records were not kept of some consults.) Samples of the three forms are included in Appendix A.

The community health aides were erroneously restocked with a version of the form that lacked the evaluation items. Consequently, their reporting on evaluation items dropped to zero when they exhausted their first batch of forms after a few months.

Before the HIS system was implemented, modifications to the standard forms to collect evaluation data were negotiated. A great deal of evaluation data was thus routinely collected on every outpatient encounter during the demonstration. The data, including the evaluation data, were keytaped from the forms and entered in computerized medical record files. Crosstabulations of the evaluation and other data in these files were a major portion of the evaluation output. The data covered in-person encounters, radio consults, and television consults for patients from experimental and some non-experimental sites.

The Health Information System records on video consultation, on which much of the following analysis is based, cover the period from September 17, 1974 to May 16, 1975. The video cases prior to these dates are probably better described as "shakedown" trials than consultations, and have been excluded in order to limit the data base to periods of relatively stable reporting and behavior.

Table 3-1 shows the evaluation items that were added to the standard HIS forms and which of these items were added to each form.

Administrative consultations, such as those concerning travel, personnel whereabouts, drug orders, and paperwork, were coded on the HIS forms but not entered into the computer. A sample was drawn from these and analyzed separately.

TABLE 3-1

Evaluation Codes Added to HIS Forms

| Code | Form | | |
|---|---|---|---|
| | M.D./PHN Encounter | Health Aide Encounter | Teleconsult |
| A. Elapsed time between onset of symptoms and entry into the health care system ... | X | X | |
| B. Whether a consult was desired and, if so, whether in video or audio ... | X | X | |
| C. The reason not accomplished if a desired consultation was not made: Video ... | X | | |
| Audio ... | X | X | |
| D. The medium of consultation ... | X | | X |
| E. The type of contact or traffic ... | | | X |
| F. The signal quality: Video ... | X | | X |
| Audio ... | X | X | X |
| G. Remote diagnostic equipment used ... | | | X |
| H. The complexity of the patient's problem ... | | | X |
| I. Effect of the consultation on the diagnosis | | | X |
| J. Effect of the consultation on the management | | | X |
| K. Effect of the consultation on the probable outcome ... | | | X |
| L. Source of the travel request ... | | | X |
| M. Disposition of the requestion for travel authorization ... | | | X |



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3.3.2 Anchorage Monitoring Logs

A monitoring log for recording medical and evaluation information about each video teleconsultation was developed at Stanford and used by a physician in Anchorage who worked for the Health Care Delivery Demonstration and monitored all video transmissions. The form contained information similar to that collected on HIS forms, plus a few additional items including the times each consult began and ended, and the importance of the difference that video made to the consultation. When the usual monitor was not able to be present, the project director, also a physician, filled out the form instead. A sample of the form is attached as Appendix B.

In order to provide an independent judgment about the monitoring log information and to provide a set of redundant measures for calculation of reliability coefficients, some of the video consultations were coded onto monitoring logs by an Anchorage physician who was an employee of the evaluation, rather than of the project.

3.3.3 Tanana Monitoring Logs

An advanced medical student from Stanford spent about six weeks in Tanana during the video teleconsultations. He used a monitoring log form that looked quite different from the physician's, but was virtually identical in substance, to record information about the consultations he observed. The monitoring log form he used is found in Appendix C.

3.3.4 Case Summaries

In addition to the monitoring logs kept by the Tanana-based medical student, he prepared structured, subjective summaries of the cases for each consultation observed. These summaries elaborated on the content and process of the consultation, investigated the long-term follow-up and outcome assessments, and included general observations on problems and experiences that were not likely to be picked up by the less open-ended data collection techniques. Approximately 45 of the 300+ video consultations

were summarized in this manner. The protocol used in preparing the summaries is included as Appendix D.

3.3.5 Health Care Provider Interviews

Prior to the initiation of service on ATS-6, structured interviews were carried out with all the health care providers who would be involved with the project. The objectives of the interview were:

(1) To determine the knowledge levels of the health care providers about the communication systems available to them.

(2) To obtain an assessment from the health care providers of priority health needs.

(3) To compare the health care providers' prediction of the usefulness of ATS-6 in meeting health needs before the experiment with their assessment of its usefulness after the experiment.

(4) To learn how health care providers use communication facilities in their work and how they rate their usefulness before and after the ATS-6 experiment.

(5) To learn how useful the health care providers found the HIS record system.

(6) To obtain opinions of health providers on the kinds of communication services required for their work and for their communities.

Identical interviews were conducted with 13 participating providers after the demonstration of video teleconsultations had concluded. The levels of health care providers interviewed included community health aides, public health nurses, a registered nurse who was running a field clinic, a physician's assistant, and physicians. The interview protocol-questionnaire used in conducting these interviews is included as Appendix E.

A series of similar but less detailed interviews was also conducted with half a dozen specialists at the Anchorage Native Medical Center who had participated in video consultations.



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Open-ended interviews were conducted with the project staff who were not health care providers.

3.3.6 Satellite Review Committee Interviews

A committee consisting of representatives from the native communities in Anchorage, Fairbanks, Tanana, Fort Yukon, and Galena was established early in the preparatory phases of the ATS-6 experiment to review the plans and give guidance to the medical community on native needs and concerns. This committee became known as the "Satellite Review Committee." Several attempts were made through the committee to collect information about the attitudes and perceived needs of the native community, preferably through a survey or a series of interviews with a sample of the population. These efforts were unsuccessful. As an alternative, questionnaires were administered to the committee members as representatives of their communities to measure attitudes toward, knowledge levels about, and expectations for the satellite experiments and the health care system, and to assess the native community priorities and perceived needs in the areas of health care and communication. Appendix F is a copy of the questionnaire used.

The interviews were conducted prior to the beginning of ATS-6 consultations. The committee's major work was completed long before the end of the demonstration, however, and the members had virtually disbanded when post-demonstration interviews were attempted. Only one current member of the committee could be reached for a second interview. However, additional interviews were also conducted with representatives of other native organizations, such as the Tanana Council of Chiefs and the Alaska Federation of Natives.

3.3.7 Minitrack Logs of ATS-1

The Minitrack Station at the University of Alaska's Geophysical Institute monitored and logged the Doctor Call radio traffic on ATS-1. A sample of their log is Appendix G. They kept these logs throughout the ATS-1 experiment, so baseline data

for villages equipped with ATS-1 equipment were available for all 14 villages from April 1973. The logs recorded signal strength and intelligibility, the numbers of patients and administrative items discussed on each day by each village, and the amount of time spent discussing them.

3.3.8 Previous Evaluation of ATS-1 Doctor Call

A wealth of additional information on Alaska and Alaskan health care was available for this evaluation as a result of this group's involvement in evaluation of the ATS-1 Biomedical Satellite experiment. That evaluation was supported by Contract No. N01-LM-1-4718 between Stanford University and the Lister Hill National Center for Biomedical Communication (National Library of Medicine). Data collected under that contract provided useful baseline and comparison sources during the current research. Insights gained as a result of the previous effort were of invaluable assistance during the current project.

## 3.4 SUMMARY

The ATS-6 Health Care Delivery project in Alaska is a demonstration, rather than an experiment. The evaluation uses a quasi-experimental non-equivalent control groups design as an underlying model, and deviates from it where appropriate. The main categories of dependent variables examined are:

-- Technical performance of the system
-- Usage of the system
-- Effects on the process of medical care
-- Effects on the outcome of medical care
-- Changes in the attitudes of the participants

The data for the evaluation come from many sources. Most dependent variables are measured by more than one instrument. Data sources and collection techniques include:

-- Real-time coding by consultation participants
-- Log-keeping by consultation observers

-- Structured interviews

-- Open-ended interviews

-- Attitude questionnaires

-- Retrospective case summaries

-- Subjective observation

-- Archival data

## CHAPTER FOUR
## PERFORMANCE OF THE DEMONSTRATION SYSTEM

The Alaskan situation poses many special obstacles to communication. The demands on equipment are often high because it must perform under severe environmental conditions. Signal degradation may be critical, because of cross-cultural language difficulties and requirements for high quality for the transmission of medical information. Because of this combination of demanding requirements and conditions, it is important to ascertain that the equipment functioned well enough to be used and accepted as part of the health care system.

This chapter focuses on the reliability of the equipment, the quality of the signals transmitted, and the reaction of the users of the system to its performance.

### 4.1 RELIABILITY OF THE EQUIPMENT

A wide variety of equipment was involved at each site. At Fort Yukon, Galena, and Tanana the installation included: three antennae and associated electronic gear -- one for communicating with ATS-1 and two for sending and receiving signals over ATS-6; studio equipment such as microphones, camera, scrambler, videotape recorder, and television monitor; electronic equipment for transmitting electrocardiograms and chest sounds; and a computer terminal for accessing the Health Information System data base in real-time.

A full-time technician was assigned to the experiment. He traveled to the sites to perform simple repairs and adjustments. For more complex problems, the technician had to remove the equipment from the field for diagnosis and repair. In some cases, he was able to "talk through" an operation by phone, guiding the local personnel and avoiding a trip to the site. This approach

can be especially valuable in Alaska, where a spell of bad winter weather can simultaneously raise the likelihood of equipment trouble, make travel difficult or impossible, and increase the importance of immediate medical communications.

### 4.1.1 The Satellite Communication Equipment

The ATS-1 satellite communications gear is fairly simple and has demonstrated high reliability under heavy use in Alaska in the Doctor Call system. It continued to function very reliably throughout the ATS-6 experiment.

The communications equipment for the ATS-6 satellite is far more complex than the ATS-1 equipment. It was developed specifically for the ATS-6 Health and Education experiments and had never had a prolonged test under operational conditions. It too functioned quite well during the experiment, but it was not wholly without problems. During one extended period of extreme cold (temperatures below minus 50°F), the ATS-6 transmitter at Tanana failed, apparently because of the cold, and was inoperable for over nine weeks. Equipment problems prevented Galena and Fort Yukon from transmitting for periods of eight and a half weeks and almost two weeks, respectively. The Anchorage station was not designed to transmit video. All stations were able to receive during the entire experiment.

Other transmission problems included inadequate performance of energy dispersal cards in S-band transmitters (October 1974), failure of preamplifier transistors at Galena (December 1974), frequency drifting in the Fort Yukon audio oscillator (January 1975), and S-band transmitter power fluctuations (March 1975).

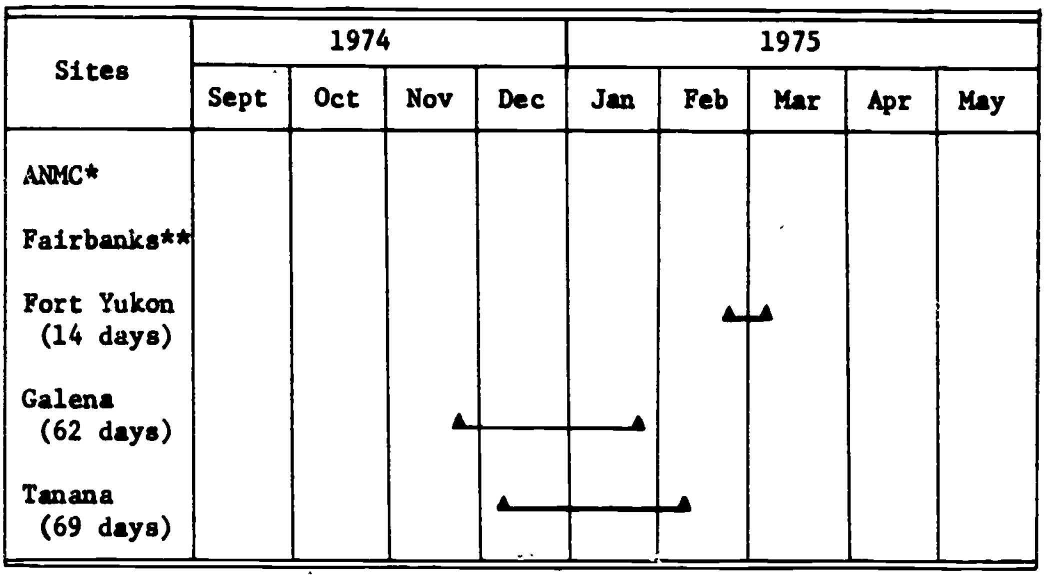
The major ATS-6 transmission outages occurred at the following times:

| | |
|---|---|
| Fort Yukon | -- February 25, 1975 to March 10, 1975 |
| Galena | -- November 27, 1974 to January 27, 1975 |
| Tanana | -- December 6, 1974 to February 12, 1975 |

These periods are shown in Table 4-1. At no time were all of the sites inoperable simultaneously; the demonstration did not miss a

TABLE 4-1

ATS-6 Transmission Downtime




*ANMC was not equipped for ATS-6 transmission.
**Fairbanks was not able to participate actively in the demonstration because of personnel shortages in the clinic.

single scheduled transmission. Demonstration personnel continued to participate as best they could. For example, when Tanana could not transmit, it could still receive video. Doctors in Tanana consulted via ATS-1.

The delays in repair of the ATS-6 satellite equipment were aggravated by difficulties in determining what actually was causing the problem. The technician had little experience with the equipment, and was forced to return the unit to the manufacturer when the problem exceeded the local repair capabilities. As a result, the length of time required to rectify problems was probably not representative of the downtime in an operational system. Administrative coordination of maintenance and repair activities would be arranged differently in a larger scale operational service conducted by a single agency. The maintenance arrangements for a small scale-scale, jointly-sponsored demonstration are not generalizable to an operational service. However, problems such as extreme cold and poor flying weather could be also expected to hamper maintenance of operational systems.

4.1.2 The Other Equipment

The other pieces of equipment varied in performance. The studio gear (cameras, lights, videotape recorders, television monitors, etc.) seemed to perform about as reliably as in ordinary studio use — that is, well but not perfectly. Problems included a camera fault in Fairbanks and malfunctioning of the Fort Yukon remote control unit.

The scramblers, which were designed specifically for this experiment, were installed soon after it began. There was a delay in the receipt of factory-modified scrambler units at Tanana, Galena, and Fairbanks, and they were not properly adjusted at these sites when installed. The scramblers proved to be rather sensitive pieces of equipment -- capable of providing the confidentiality they were intended to ensure, but usually at the cost of some degradation of the video picture quality.

An electronic stethophone was used for transmitting heart and chest sounds over the satellite. This piece of equipment did not produce signals of a quality high enough for medical use. It is not clear whether the problem was one of malfunctioning equipment, too low a signal strength and quality to permit transmission over the satellite, or lack of adequate instruction in the use of the equipment.

Each site was supplied with a transmitting electrocardiogram that could produce heart tracings locally or transmit a signal that would cause a similar machine in a remote location to produce a heart tracing. There were no serious problems with this device, although signals from the Fort Yukon unit were abnormally noisy in December 1974.

For a more detailed summary of equipment malfunctions and difficulties, see the final report of the University of Washington Project Office (University of Washington, 1975).

## 4.2 SIGNAL QUALITIES

It is important to examine quality as well as reliability because without a signal quality high enough to permit reasonable interaction, the demonstration could not be expected to produce meaningful results.

The quality of the received signal at any site is affected by many variables. The studio and transmitting equipment at the transmitting site, the satellite, and the receiving station's equipment must be functioning properly. The ATS-1 and ATS-6 satellites use different equipment and different frequencies. Thus the received signal quality for each medium of transmission and for each site can vary more or less independently.

Technical quality alone is not sufficient for a successful demonstration; the signal quality must be adequate to the medical tasks to be accomplished.

Medical care personnel who rated signal quality were asked to rate the adequacy of the signal quality for accomplishing

that day's medical tasks. This relative judgment was used, rather than an absolute judgment, for a number of reasons. First, absolute ratings of the technical signal qualities were available from other sources. Second, experience with the ATS-1 satellite experiment had demonstrated that the technical or absolute rating of the signal quality almost always placed the signal in the highest or next highest category — in short, the communication channels were capable of functioning quite well in a technical sense. And third, the relationship between the technical signal qualities attained and their usefulness for medical purposes has important implications for the planning of possible future telemedicine activities.

At each site, for each consultation, the adequacy of each communication channel was rated. There were thus separate judgments of the adequacy for medical purposes of the signal quality of the video picture, the video sound, the ATS-1 voice channel used for a talkback link during video consultations, and the ATS-1 channel when used for radio consultations in Doctor Call. The ratings were made by primary health care providers at the remote clinics, the physician consultants at the Tanana field hospital, and by a physician who monitored all video consultations from Anchorage. The medical personnel rated the signal qualities for each teleconsultation using a scale of "1" to "4". A "1" rating meant "totally inadequate for the medical task at hand," a "2" meant "marginally adequate," a "3", "satisfactory," and a "4", excellent."

4.2.1 ATS-6 Picture and Sound

The adequacy of the ATS-6 picture and sound for medical tasks is satisfactory at least 80 to 90% of the time. The primary providers and the consultants made one judgment for the quality of the picture and sound combined. The monitoring physician made separate judgments for the picture and the sound. Table 4-2 shows the combined picture and sound ratings made by providers and consultants. The mean ratings were 3.6 and 3.7,

TABLE 4-2

**Percentages of Cases with Given Ratings of Adequacy of Signal Quality for Medical Purposes of the ATS-6 Picture and Sound Combined**

| Rated by: | Adequacy of Signal Quality | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | MEAN | # OF CASES |
| Consultants | 1.1% | 4.8% | 29.4% | 64.7% | 3.58 | 269 |
| Providers | 4.9% | 5.7% | 6.6% | 82.8% | 3.67 | 122 |

Codes: 1 = totally inadequate
2 = marginally adequate
3 = satisfactory
4 = excellent

which indicates a high degree of satisfaction with the video. The percentages of cases classed as "satisfactory" or "excellent" were 89% and 94%.

Table 4-3 gives the separate ratings of the video picture and sound made by the physician monitor at Anchorage. She used the same scale, but on a different form from the consultation participants. The ratings of the ATS-6 audio and video channels were quite similar to each other, but slightly lower overall than those made by the participants in the consultation. The means for the picture and sound ratings were 3.30 and 3.34, both of which were well above "satisfactory." The percentages of cases classified as "satisfactory" or better were 81% and 82%.

There is no obvious reason why this rater's evaluations of the adequacy of the signal quality should be lower than those of her colleagues. It is possible that reception in Anchorage was generally of lower quality than at the other locations. It is also possible that this rater was simply applying more demanding standards.

4.2.2 ATS-1 Sound

The ATS-1 satellite is involved in this demonstration in two ways. It is used in Doctor Call, the daily program of satellite radio consultations between 15 community health aides and a physician at Tanana. It is also used in the ATS-6 demonstration to provide a voice channel over which the sites that are not transmitting video can talk. For example, when a nurse at a remote clinic is transmitting a television picture of a patient and talking on the television's sound channel, physicians in Anchorage and Tanana talk to the remote clinic and to each other over the ATS-1 channel.

4.2.2.1 ATS-1 Use in Video Consultations

The users were generally satisfied with the adequacy of ATS-1's signal quality during video consultations. When used in conjunction with ATS-6 to support video consultations, the ATS-1 signal quality's adequacy was rated by providers, consultants,

TABLE 4-3

**Percentages of Cases with Given Ratings of Adequacy of Signal Quality for Medical Purposes of the Picture and Audio Portions of ATS-6, Rated by a Physician Monitor**

| Rating of: | Adequacy of Signal Quality | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | MEAN | # OF CASES |
| ATS-6 Picture | 1.0% | 17.9% | 31.0% | 50.0% | 3.30 | 290 |
| ATS-6 Sound | 6.4% | 11.8% | 20.4% | 61.4% | 3.34 | 280 |

Codes: 1 = totally inadequate
2 = marginally adequate
3 = satisfactory
4 = excellent

and the monitoring physician at Anchorage. Table 4-4 summarizes the ratings assigned when ATS-1 is used as the talkback link in video consults. The mean ratings were uniform and fairly high, and the percentage of cases classed as "satisfactory" or "excellent" ranged between 88% and 95%.

4.2.2.2 ATS-1 Use for Doctor Call

The signal quality of ATS-1 in Doctor Call is rated very high, both in terms of adequacy for the medical tasks and in a strictly technical sense.

Table 4-5 presents the results of the ratings of the ATS-1 satellite signal quality when used for Doctor Call. The mean value for both providers and consultants is between "satisfactory" and "excellent," and over 95% of the cases are rated as "satisfactory" or better. These results agree quite closely with those reported in the previous evaluation of Doctor Call (Kreimer et al., 1974).

A measure of the technical quality of the ATS-1 channel was made by the staff of the Geophysical Institute at the University of Alaska at their "Minitrack" satellite tracking station. The log kept at the Minitrack station recorded, among other things, ratings of the strength and intelligibility of the signals received at Fairbanks from each of the sites participating in Doctor Call each day. The majority of these sites were not actively involved in the ATS-6 experiment. However, the same equipment is used for ATS-1 communication in both projects.

The ratings were made separately for signal strength and intelligibility from each site each day. A five-point scale is used for the ratings, with "1" being the lowest and "5" the highest possible rating. Ratings of strength refer to the reading on a meter on the reception equipment; ratings of intelligibility refer to a standard scale ranging from "1" for "unreadable," that is, the listener cannot understand what the speaker is saying, to "4" for "readable with practically no difficulty," and "5" for "perfectly readable." Table 4-6 shows the

TABLE 4-4

**Percentage of Cases with Given Ratings of Adequacy of Signal Quality for Medical Purposes When ATS-1 is Used to Support ATS-6 Consults**

| Rated by: | Adequacy of Signal Quality | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | MEAN | # OF CASES |
| Consultants | 0.7% | 4.6% | 16.3% | 78.4% | 3.72 | 282 |
| Providers | 7.4% | 5.0% | 2.5% | 85.1% | 3.65 | 121 |
| Monitor | 0.8% | 6.5% | 22.4% | 70.2% | 3.62 | 245 |

Codes: 1 = totally inadequate
2 = marginally adequate
3 = satisfactory
4 = excellent

TABLE 4-5

Percentage of Cases with Given Ratings of Adequacy of Signal Quality When ATS-1 is Used for "Doctor Call"

| Rated by: | Adequacy of Signal Quality for Medical Purposes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | MEAN | # OF CASES* |
| Consultants | 0.1% | 1.6% | 9.3% | 88.9% | 3.87 | 1299 |
| Providers | 2.1% | 2.8% | 24.1% | 71.0% | 3.64 | 145 |

Codes: 1 = totally inadequate
2 = marginally adequate
3 = satisfactory
4 = excellent

*The large difference between the numbers of cases in each population results from the fact that the Tanana physicians consult regularly with about 15 villages, but only a few of these villages fill out the Health Information System forms from which these ratings are taken. The physicians complete forms for every village with which they consult.

TABLE 4-6

Percentages of Cases* Rated in Given Signal Strength and Intelligibility Categories for "Doctor Call" on ATS-1 from January 1, 1974 to March 16, 1975

| Strength \ Intelligibility | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0.2% | 0 | 0 | 0 | 0.2% |
| 3 | 0 | 0.2% | 0.5% | 0.2% | 0.4% | 1.3% |
| 4 | 0 | 0.1% | 1.8% | 7.6% | 1.7% | 11.2% |
| 5 | 0.1% | 0 | 0 | 20.2% | 67.0% | 87.3% |
| | 0.1% | 0.5% | 2.3% | 28.0% | 69.1% | 100.0% |

*These figures are calculated from a sample drawn from all the logs for the period. The sample consisted of randomly selected composite weeks, that is, one Sunday, one Monday, one Tuesday, etc., from each month during the period. The sample contained 1,805 total cases, of which 481 were blank, which probably indicates that the site did not respond when polled during "Doctor Call" and hence could not be coded. Another 14 cases were excluded because they faded in and out from high to low quality and could not be coded. The above percentages are thus based on an N of 1,310.

percentages of cases falling into each combination of the categories.

In virtually all of the cases in which a station answered Doctor Call and its signal strength and intelligibility were recorded, both strength and intelligibility were very good or excellent. As can be seen from the marginal totals, 98% of the recorded cases were judged either "4" or "5" in strength. Similarly, 97% of the cases were judged either "4" or "5". Ninety-seven percent of the cases were rated either "4" or "5" in both strength and intelligibility.

## 4.3 ATTITUDES AND COMMENTS OF THE USERS

Project participants generally found reliability and signal quality to be acceptable for their needs. Thirteen health care providers of all levels who were regularly involved with the ATS-6 experiment were interviewed before and after the ATS-6 project to determine their attitudes toward the system. In the pre-experimental interviews, the providers expressed concern about the likelihood of electrical and mechanical breakdowns, maintenance of the equipment, and the possibility that the equipment capability would fall short of that which would be necessary for remote consultations. Concerns about the reliability or signal quality of the coming system constituted 25% of the anticipated problems enumerated by the providers during the pre-experimental interviews. When asked the same question in the post-experimental interviews, comments about technical failures or shortcomings constituted 29% of the responses, or a roughly equal proportion.

Providers were also asked what features they liked and disliked about the ATS-1 and ATS-6 consultation systems. Of the comments about "liked" features of the ATS-1 Doctor Call system, 30% had to do with its reliability and dependability, and another 20% referred to its high sound quality compared to the old, notoriously unreliable High Frequency radio network. None of the responses about "liked" features of the ATS-6 system specifi-

cally mentioned either reliability or signal quality, although 25% of the responses cited the ability to transmit X-rays and electrocardiograms as advantages, which presupposes a certain satisfaction with the signal quality. (It appeared that respondents were comparing ATS-6 with ATS-1, rather than with the HF network. Since both satellite systems were highly reliable, signal reliability was not a differentiating factor.)

When asked to name features of the ATS-1 and ATS-6 systems that they disliked, none of the ATS-1 responses or ATS-6 responses concerned signal quality. Nine percent of the ATS-1 responses concerned the lack of training of local users in simple maintenance procedures, and 10% of the ATS-6 responses cited the technical problems they had encountered as "disliked" features.

About a dozen other people whose involvement with the ATS-6 system was more episodic than regular were also interviewed. The majority of less structured interviews were with Anchorage specialists who had acted as consultants during video consultations. Several specialists mentioned technical problems that limited their capabilities over ATS-6. An internist noted that the transmission of heart and breath sounds was never clear enough to be useful to him; transmitted EKGs were, he said, of good enough quality but were very time consuming to perform during a consultation. He and two other specialists cited variability of quality in the transmission of X-rays as a problem. Sometimes the resolution was very good, at other times quite marginal. Seldom, if ever, were such problems as microfractures or possible wrist fractures discernible from the transmitted X-rays. However, the specialists reported that the quality of the video transmissions was satisfactory for the vast majority of cases.

## 4.4 SUMMARY

On the whole, the equipment used in this experiment performed reliably. Downtime was primarily due to length of time taken in equipment repair rather than to persistent malfunction. The

problems with the satellite communication equipment, in particular, were not severe and would probably be less troublesome in an operational environment, where both the scale of operation and the locus of administrative responsibility for maintenance would be different. The importance of designing equipment for easy maintenance in rugged and inaccessible environments was demonstrated. The impact of Alaskan distances and climate on repair and maintenance arrangements must be kept in mind for operational service planning.

Both ATS-6 and ATS-1 signals were consistently reliable and were adequate for the great majority of the medical cases encountered. Users of the system seldom felt overly constrained by the system's signal quality limitations.

The core satellite equipment, while complex, was not too sensitive for operational use by non-technicians, provided that technical help and maintenance could be obtained when needed. Providers felt that the existence of a reliable communication channel to bush communities, even one as basic as that provided by ATS-1, made an immeasurable improvement in their ability to provide health care to bush residents.

## CHAPTER FIVE

## USAGE OF THE DEMONSTRATION SYSTEM

### 5.1 DESCRIPTION OF THE ATS-6 MEDICAL CONSULTATIONS

The ATS-6 video consultations began on an irregular trial basis even before the demonstration was officially scheduled to start. During September 1974, the demonstration began in earnest, and thereafter transmitted successfully in each scheduled period allotted; i.e., three times a week for one hour, from 11:30 a.m. to 12:30 p.m., Anchorage time, on Mondays, Wednesdays, and Fridays. On rare occasions this time slot was extended for a few minutes to permit completion of emergency consultations.

#### 5.1.1 Numbers of Consultations

An average of three to four patients per day were presented over ATS-6, for a total of over 300 during the demonstration. The satellite demonstration was concluded on May 16, 1975, giving a total of 104 scheduled transmission days in the HIS data base. Transmissions were carried out on both Christmas and New Year's Day because of urgent cases arriving in the remote clinics. During this demonstration period, records from 318 video consultations were added to the HIS files. The ATS-6 monitoring logs from Anchorage, covering a period two weeks shorter, contain information about 305 patient consultations. Each data base appears to contain information about a few consultations not represented in the other. For instance, a number of consultations found in the monitoring logs concern presentation of X-rays for specialist review. The specialist would not ordinarily file an HIS report in this situation; hence, there would be no corresponding case in the HIS file. Some Tanana to Anchorage consultations were not recorded in HIS. Similarly, HIS forms were completed for patients who for some reason were not entered into the monitoring log. Consequently,

it seems safe to assume that the actual number of cases presented during this period was between 325 and 350. Table 5-1 presents the distributions of cases during the experimental period.

According to each set of records, the average number of patients per scheduled transmission was slightly over three. However, there was a fairly strong trend toward handling a larger number of patients during the latter half of the experiment. If one looks only at the second half of the experimental period, the average number of consultations per day was about 3.7, according to the HIS records, and about 4.0, according to the monitoring log cases. This difference over time was probably the result of increased efficiency as providers gained experience with the system.

5.1.2 Length of Consultations

Video consultations take longer than radio consults. Interaction about a patient takes an average of 12 minutes, and an average of another three to eight minutes per patient is required for setting up technical arrangements.

The physician who monitored the transactions from Anchorage recorded the start and stop times for each patient consultation. The model interval was six to ten minutes. The distribution of the elapsed time is given in Table 5-2. Nearly 75% of the consultations took 15 minutes or less to complete. The shortest consultation lasted one minute, and the longest lasted 53 minutes. The average time required to present and discuss a patient was about 12 minutes.

However, the average of three to four consultations per day implies that the average time required to conduct a consultation was between 15 and 20 minutes. During this time a station would probably have to ready its camera and transmitter, make sure that the appropriate consultants were available and perhaps wait for them to arrive, bring in the patient, and then present and discuss the case.

All of the activities not directly related to presenting or discussing a patient may be thought of as a type of "overhead"

required for arranging technical and practical details. The overhead time may represent a significant proportion of the total transmission time. In this project, the minimum estimate of the average overhead time was at least three minutes, or 25% of the time spent consulting about the patient. The maximum estimate of the average overhead time, based on the available data, was eight minutes, or an additional 75% of the time spent discussing the patient.

A perspective on these figures can be gained by comparing them to the lengths of consultations made on the ATS-1 system. ATS-1 Doctor Call consults were generally much shorter, but "overhead" time to establish contact was also required. The average elapsed time per patient consultation in Doctor Call on ATS-1 was about three minutes, both in the previous evaluation of the ATS-1 system and in the sample of ATS-1 Minitrack logs examined for this evaluation. The Doctor Call exchanges were almost all between village health aides and a doctor, and most of the cases were neither very severe nor very complex.

A more comparable use of ATS-1 was the consultation between a doctor on St. Paul Island in the Pribilofs and specialists in Anchorage. These consultations presumably dealt with the remote doctor's more complex or severe cases, and they lasted an average of six minutes per patient consultation.

Occasionally, an ATS-6 consultation could not be completed before the scheduled satellite period had run out. In a few instances, an extension of satellite time was requested and granted to permit the completion of particularly urgent consultations. Usually, however, a consultation that had not been completed was simply cut off. The monitoring log records indicate that 28 of the 284 clinical consultations for which information on this variable was available were cut off before completion. This amounts to nearly 10% of the codable cases, or 9% of the total cases.

TABLE 5-1

Numbers of Video Consultations Performed on ATS-6 Between September 17, 1974 and May 16, 1975, According to the Health Information System and the Anchorage Monitoring Logs

| Date | HIS | Monitoring Log |
|---|---|---|
| Sept.-Oct. 1974* | 28 | 10 |
| Oct.-Nov. 1974 | 39 | 37 |
| Nov.-Dec. 1974 | 25 | 24 |
| Dec. 1974-Jan. 1975 | 32 | 28 |
| Jan.-Feb. 1975 | 42 | 42 |
| Feb.-Mar. 1975 | 33 | 32 |
| Mar.-Apr. 1975 | 53 | 67 |
| Apr.-May 1975 | 66 | 65 |
| Total # of cases | 318 | 305 |
| Number of transmission days | 104 | 98 |
| Average number per day | 3.06 | 3.11 |
| Average number per day in second half of experimental period | 3.73 | 3.96 |

*The HIS data began on September 17, 1974 and the monitoring log data began on October 1, 1974.

TABLE 5-2

**Distribution of Elapsed Times for Presenting and Discussing a Patient Over ATS-6**

| Elapsed Time | % of Cases |
|---|---|
| 1-5 minutes | 23.5% |
| 6-10 | 30.5 |
| 11-15 | 20.4 |
| 16-20 | 10.1 |
| 21-25 | 7.0 |
| 26-30 | 4.2 |
| 31-35 | 2.5 |
| 36-40 | 0.0 |
| 41-45 | 0.4 |
| 46-50 | 1.1 |
| 51-55 | 0.4 |

**Note:** Average time per patient = 12.05 minutes
Number of cases = 285

TABLE 5-3

**Number of Times Each Site Assumed a Particular Role in ATS-6 Consultations**

| | Role Assumed by Site | | | | |
|---|---|---|---|---|---|
| Location | Presenting a patient | Actively participating | Listening | Not participating or role unknown | Item Left Blank |
| Anchorage* | 2 | 288 | 3 | 0 | 13 |
| Fairbanks | 0 | 10 | 31 | 233 | 32 |
| Fort Yukon | 142 | 25 | 70 | 44 | 25 |
| Galena | 53 | 20 | 99 | 103 | 31 |
| Tanana | 53 | 225 | 4 | 0 | 24 |

*The two cases in which Anchorage is said to have presented patients are probably miscodes; Anchorage did not have video transmission equipment.

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Premature termination of a consult is definitely a problem with a system that is rigidly scheduled, but it may not be as serious as these figures indicate. In an effort to make maximum use of the available satellite time, non-critical presentations, often of X-ray films, were made at the end of the days' schedule when little time remained. When these types of presentations were cut off, little harm was done.

5.1.3 <u>Participation by the Sites</u>

Originally, five sites were to be involved in the video demonstration: Anchorage, Fairbanks, Fort Yukon, Galena, and Tanana. All of the sites except Anchorage were to have the ability to transmit and hence to present patients. Anchorage was to be able only to receive video without transmitting a picture, and to participate by talking over ATS-1. In the planning stages of the demonstration, it was expected that each day patients would be presented serially from several sites to consultants at Anchorage, Fairbanks, or Tanana. In practice, however, this procedure was modified. Staff shortages at the Fairbanks clinic made it nearly impossible for them to participate; eventually some of their equipment was "cannibalized" for other sites. Prolonged outages at the remaining sites precluded them from participating some of the time. Fort Yukon turned out to be the heaviest user of the system.

The role played by each site was recorded on the monitoring log for each patient consultation as either "presenting a patient," "actively participating in a consultation," "listening without participating," "not participating at all; set turned off," and "unknown." Table 5-3 presents the numbers of times each site assumed each role.

A close examination of the table reveals that there are a few problems with the data on which it is based. Anchorage is said to have presented patients twice, but lacked video transmission equipment. These two cases are obviously miscoded. The total for the first column, "presenting a patient," is only 250, which leaves 55 patient presentations unaccounted for. If these

missing cases are not distributed proportionally among the sites, they might alter the apparent distribution of activity. Finally, not all sites had the same opportunity to present patients because of periods when the transmitters were inoperable. The maximum number of days that the three primary sites, Fort Yukon, Galena, and Tanana, could have presented patients were 99, 78, and 75, respectively.

Even taking these differences into account, there are still marked differences between the sites in the ratio of patients presented to possible transmission days. Fort Yukon presented 1.4 patients per possible transmission and accounted for 56.8% of total patient presentations. Galena and Tanana each presented 21.2% of the cases, or 0.7 per possible transmission.

5.1.4 <u>Use of Diagnostic Devices</u>

As a part of the demonstration, the remote sites were supplied with an electronic stethophone and a transmitting electrocardiograph. The clinic at Fort Yukon and the hospital at Tanana had X-ray equipment and could present the films on camera. Both the physicians at Tanana and the physician monitor at Anchorage were to record on their forms each time one of these diagnostic devices was used. Table 5-4 presents the tabulations of these records.

Both sources of data exhibit the same pattern, but the level of reporting on the monitoring log is much higher. Since the method of recording use of a diagnostic device was to circle its name or code number, these frequencies probably represent estimates of the lower limits of actual use of the devices. In some consultations, more than one device was used and recorded.

5.1.4.1 <u>X-rays</u>

The presentation of X-ray films was found to be one of the chief advantages of the video link. The physician who monitored the ATS-6 consultations from Anchorage reports their use in nearly 45% of the consultations, a surprisingly high figure. One explanation for the high proportion of cases involving X-rays is that

TABLE 5-4

Use of Diagnostic Devices in Video Consultations

| Record | Device Used | | | Total Cases |
|---|---|---|---|---|
| | Electronic Stethophone | Electro-Cardiogram* | X-ray | |
| HIS Forms:<br># of times used<br>% of total cases | 3<br>0.9% | 6<br>1.9% | 64<br>20.1% | 318 |
| Monitoring Log:<br># of times used<br>% of total cases | 10<br>3.3% | 20<br>6.6% | 137<br>44.9% | 305 |

*Cases coded for use of electrocardiogram probably include cases in which a locally made heart tracing was put in front of the camera, as well as cases in which the transmitting electrocardiogram was used to generate a tracing at the consultant's site.

the health care providers involved in the demonstration found that presenting an X-ray was a convenient and productive way to fill small blocks of time at the end of a day's schedule. If no patients remained to be presented, or if the time until the end of the schedule was too short, they could usually squeeze in one or two X-ray presentations. Even if the appropriate specialist was not present at the receiving station, he could later view it on videotape.

The ability to get consultants' reactions to X-rays without waiting for the mail was an important contribution of the video consultation system.

5.1.4.2 <u>Other Diagnostic Devices</u>

The ability to present electrocardiograms, either by transmitting the signal or showing the tracing on the television screen, was a useful contribution. The electronic stethophone could not be made to transmit an adequate signal for medical use in this demonstration.

One of the participating physicians reported that, in his experience, the electronic stethophone had never worked. The reported use of the stethophone in more than 3% of the cases probably represented "trying it out" in repeated attempts to overcome the problems experienced. It cannot be used as an indicator of the proportion of cases in which a functioning electronic stethophone would be useful.

Electrocardiographic information was presented in two ways. Sometimes the remote provider would transmit a signal so that a heart tracing would be produced at the consultant's site. This procedure had the advantage of providing a hard-copy record for the consultant and the disadvantage of being quite time consuming.

Alternatively, the remote provider could make a tracing locally prior to the scheduled transmission time, and then simply focus the camera on the tracing during the consultation. This procedure was both faster and more convenient, and enabled presentation of transient arrhythmia which might not have occurred at the time of the broadcast. There was also the advantage that the

patient did not have to be present at the time of the broadcast. However, there was some inconvenience if the appropriate consultant could not be present during the satellite schedule, or if advice from additional consultants was desired later. In those cases the consultants had to come to view the videotape to see the EKG, rather than simply examining a paper copy. The 20 cases in which electrocardiograms are reported to have been presented include both methods of presentation. Consultants reported during interviews that the quality of both methods of presentation was usually adequate for the kinds of decisions required during a consultation.

#### 5.1.5 Use by Primary Providers of Different Skills Levels

During the demonstration, patients were presented by local primary providers of all levels of training from community health aide to physician. The regular staffs at the two remote clinics inlcuded nurses, a physician's assistant, and a community health aide. Additionally, health aides from Huslia, Venetie, and Nulato accompanied patients from their villages to Galena or Fort Yukon and presented them successfully over the video system. A high level of medical training was not a prerequisite for successful use of the video teleconsultation system.

### 5.2 DESCRIPTION OF ATS-1 USAGE FOR DOCTOR CALL

The daily Doctor Call over ATS-1 was an important part of the context within which the ATS-6 demonstration took place. It demonstrates that village health aides with only a few months training can supply good health care when supported by consultation with physicians. It also demonstrates the importance of administrative communication and the value of on-demand access to consultations for emergency situations.

Each day a doctor at the Tanana Field Hospital tried to contact 15 villages over the ATS-1 satellite. A sample was drawn from the Minitrack logs for this analysis. During the sampled days, the doctor was successful in establishing a contact in 79% of those cases. According to a previous evaluation of Doctor Call,

contact was established on 86% of the attempts. On an average day's Doctor Call, the doctor would discuss a total of 10 patients and 12 administrative items. These administrative items, usually non-patient-related, are an important part of the health care communication capability made possible by ATS-1.

Medical matters were discussed in 50.8% of the completed contacts, and administrative items in 57.4%. An average patient consultation lasted three minutes, and an average administrative item took one minute. These times are identical to those reported in the early ATS-1 study (Kreimer et al., 1974).

5.2.1 Emergency Calls

The ATS-1 system provides an alarm buzzer through which the remote sites can alert the hospital that they need an emergency consultation outside of the scheduled Doctor Call hours. The ability to get help quickly in an emergency is vital to the functioning of the community health aide system. During the sampled period, there were 13 emergency contacts logged, for an annual rate of approximately 31 emergencies per year. Because the emergencies occur at odd times, it is possible that a few were not logged and that these estimates are somewhat low. The emergency cases included patients with the following problems:

-- Drug reaction due to alcohol intake
-- Head lacerations
-- Serious burns over half the body
-- Vomiting blood
-- Very high fever
-- Stab wound
-- Strained wrist
-- Deep cut on leg
-- Mental disorder

5.2.2 Administrative Interaction

The communication of administrative information occupied an important place in Doctor Call. Most of it is not related to

individual patients. The HIS system appears to capture virtually all of the medical data recorded by physicians during Doctor Call.

The Minitrack logs indicate that administrative items outnumbered patient consultations and occurred in 57% of all completed contacts. In order to learn more about administrative communication, an analysis was made of items that were recorded by physicians during Doctor Call, but not entered into the HIS data base. The physicians probably record only a fraction of the administrative items they discuss.

An average of about 210 items per village per year that were written on the teleconsult forms were not entered into HIS. Non-patient related items accounted for 84% of the total, but 67% of the total were notations of "no contact" or "no traffic." Thus, about 17% of non-entered notations were true administrative items. Information about the content of the administrative communication is only rarely recorded; it appears from the few recorded cases that the items concern such things as drug orders that the health aide has placed, scheduling and travel arrangements for field visits, public health matters, and satellite equipment problems.

Patient-related items that were not entered into HIS accounted for the other 16% of the total. About one in seven of these patient-related items did not contain enough information for positive identification of the patient; in these instances no record could have been added to the file. Six out of seven concerned identifiable patients. The content of most of these was not appropriate for inclusion into HIS. Questions about appointments or travel schedules, drugs or therapy plans, or comments to the effect that "Mr. X is doing fine" are typical examples of such content. About a third of the items concerning identifiable patients, or about 5% of all items not entered into HIS, were actual medical problems. Thus it appears that the HIS system is capturing virtually all the relevant medical records generated by the consultation system.

## 5.3 USE OF ATS-6 FOR EDUCATION AND TRAINING

The major goal of installing the ATS-6 equipment was to explore its use in delivering medical services to remote locations. However, it was recognized that the system also offered a high potential for continuing education of remote providers. Making use of the educational possibilities of the satellite emerged as a secondary goal of the demonstration.

The main use of the ATS-6 equipment for education was in showing videotapes or televising lectures for the continuing professional education of the health care providers. Instruction included topics such as emergency care, physical therapy, dehydration in infants, hypothermia treatment, chronic bronchitis, electrocardiograms, and orthopedics. One educational videotape on venereal disease was played for a group of high school students and was very favorably received. Two transmissions were devoted to training and the attempted practice in the use of the transmitting electrocardiogram and the electronic stethophone.

According to the Anchorage monitoring logs, the satellite was used a total of 19 times for educational or training transmissions. Table 5-5 shows when the satellite equipment was used for education.

The majority occurred during the second half of the demonstration. The last four months of the demonstration accounted for 89% of all educational transmissions. The probable reason for this uneven distribution was that the educational uses were of secondary importance and were put off until other portions of the demonstration were well in hand.

An educational transaction took longer than a clinical consultation. The average length of educational transmissions was 16.2 minutes. Table 5-6 presents the distribution of lengths of educational transmissions.

One factor influencing the length of the transmissions was the satellite scheduling constraints. Educational transmissions were usually not begun until the day's clinical business had been

TABLE 5-5

Use of ATS-6 for Educational Transmissions, by Month

| Month | Number | Percent of Total |
|---|---|---|
| Sept.-Oct. '74* | 0 | 0.0% |
| Oct.-Nov. | 0 | 0.0 |
| Nov.-Dec. | 2 | 10.5 |
| Dec.'74-Jan.-75 | 0 | 0.0 |
| Jan.-Feb. | 1 | 5.3 |
| Feb.-Mar. | 6 | 31.6 |
| Mar.-Apr. | 4 | 21.0 |
| Apr.-May | 6 | 31.6 |
| TOTAL | 19 | 100.0% |

*"Months" in this table are measured from the 17th of one month to the 16th of the following month. Recording of data in the first month began on the 1st of October.

TABLE 5-6

Duration of Educational Transmissions on ATS-6

| Minutes | Number | Percent of Total |
|---|---|---|
| 1-5 | 2 | 14.3% |
| 6-10 | 3 | 21.4 |
| 11-15 | 2 | 14.3 |
| 16-20 | 3 | 21.4 |
| 21-25 | 3 | 21.4 |
| 26-30 | 0 | 0.0 |
| 31-35 | 0 | 0.0 |
| 36-40 | 0 | 0.0 |
| 41-45 | 0 | 0.0 |
| 46-50 | 1 | 7.1 |
| TOTALS* | 14 | 99.9% |

*Five of the 19 educational transmissions were not coded for duration.

completed. Often it was not possible to finish an educational session in the remaining time. Educational transmissions were also employed in a way similar to X-ray presentations, i.e., as a convenient and productive way to utilize small time blocks at the end of a day's scheduled time. According to monitoring log records kept at Anchorage, 64% of the educational transmissions were ended prematurely because satellite time ran out. Thus it is difficult to conclude from the information available how much time an average educational interaction would require if it were not so severely limited by the constraints of the demonstration situation.

The signal quality was rated separately for each of the transmission media. Signal quality ratings were made on the same four-point scale used for rating the signal quality's adequacy for medical purposes. Table 5-7 summarizes the signal quality ratings made during educational transmissions. The ratings are fairly high and consistent with the ratings of medical transmissions, except that the ATS-6 picture quality was rated much higher in educational uses. Apparently, the educational transactions did not demand as high a quality of picture.

## 5.4 SUMMARY

During 104 scheduled transmission days between the 17th of September, 1974, and the 16th of May, 1975, 318 video consultations were transacted, according to records in the HIS files. Nineteen educational transmissions were also conducted during that time. An average of between three and four patients were seen each day, each taking an average of about 12 minutes. Radio consultations, by comparison, last approximately three minutes with health aides and six minutes between two physicians. About 10% of the video medical interactions were cut off before completion by termination of that day's satellite schedule. X-rays were presented in nearly 45% of the clinical transmissions on video; other diagnostic devices were rarely used.



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TABLE 5-7

**Signal Quality Ratings of All Communication Channels Used in Educational Transmissions on ATS-6**

| Signal | Signal Quality | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Mean |
| ATS-6 Picture* | 0 | 0 | 5.9% | 94.1% | 3.94 |
| ATS-6 Sound | 5.9% | 5.9% | 23.5% | 64.7% | 3.47 |
| ATS-1 | 0 | 5.9% | 11.8% | 82.4% | 3.77 |

Codes: 1 = totally inadequate
2 = marginally adequate
3 = satisfactory
4 = excellent

*A total of 17 were coded for signal quality for each channel.

## CHAPTER SIX

## TYPES OF CASES INVOLVED IN TELECONSULTATION

The most noteworthy characteristic of patients and diagnoses encountered in the teleconsultations is their diversity. This chapter will describe the patients and complaints presented over the satellites during the demonstration.

### 6.1 CHARACTERISTICS OF THE PATIENTS

There were 306 clinical cases presented on ATS-6 for which monitoring logs were kept at Anchorage. Of these, the sex of the patient was unreported in 55 cases. The patients were male in 55% of the coded cases and female in 45%.

#### 6.1.1 Ages of the Patients

Patients of all age groups were seen during the demonstration, in a fairly uniform distribution. Table 6-1 presents the distribution of ages encountered on ATS-6, and compares it with the distributions found in Doctor Call on ATS-1 and in the native population as a whole.

Examination of the table reveals that the distributions of ages of patients seen on ATS-6 and ATS-1 were not strikingly different from the general population or from each other. There were differences, however. The proportion of ATS-6 patients over age 34 was much higher than the population proportion. In the case of ATS-1, patients between zero and three years were discussed more frequently than their proportion of the population. This is as would be expected; infants and older people are seen by health care providers more often than children and young adults.

If the percentage distribution of ages for the ATS-6 and ATS-1 consultations are compared with the general population percentages, ratios can be formed that show how much more or less frequently a given age group was seen by health care providers



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TABLE 6-1

**Age Distributions of Patients "Seen" by Satellite Video and Satellite Radio, and of the Native Population**

| Age Range | ATS-6* | ATS-1** | Native Population*** |
|---|---|---|---|
| 0-3 yrs. | 14.5% | 22.2% | 15.0% |
| 4-13 | 19.8 | 23.7 | 29.3 |
| 14-23 | 16.1 | 14.6 | 18.5 |
| 24-33 | 10.1 | 12.5 | 14.1 |
| 34-43 | 12.1 | 7.2 | 9.6 |
| 44-53 | 10.5 | 6.7 | 6.8 |
| 54-63 | 8.5 | 5.7 | 3.9 |
| 64 and over | 8.5 | 7.4 | 2.7 |

*Percentages based on 248 coded cases.
**Percentages based on 1,484 coded cases.
***Source for data: Alaska Natives and the Land, 1968.

than would be expected on the basis of population. In such a ratio, a value of 1.0 would mean that the group sought health care just as frequently as would be expected from their proportion of the population. A value of less than 1.0 would mean that they were seen less frequently, and a value of greater than 1.0 would mean that the age group sought health care proportionately more often than the rest of the population.

Table 6-2 shows these ratios for comparisons of the ages of ATS-1 and ATS-6 patients to the general population. The ATS-6 and ATS-1 patients represent a sample of the general population that is weighted toward older people. However, there were differences between the patient populations discussed over ATS-1 and ATS-6. ATS-6 did not have the "bulge" of very young patients in its distribution and was more heavily weighted toward middle-aged and older patients.

It is possible to regard the ATS-1 age distribution as the distribution of the population of patients seen. One can then compare ATS-6 and ATS-1 directly by treating the ATS-6 group as a sample of the patient population. Column 3 in Table 6-2 presents the ratios of this comparison.

Video consultations differed from audio-only consultations (and thus presumably from general outpatient care, because ATS-1 and the health aides are the bases for outpatient care in the villages) in a number of ways. ATS-6 dealt with considerably fewer young children, with considerably more middle-aged patients, and with slightly more elderly patients than does ATS-1.

6.1.2 Residences of the Patients

People from practically every village in the ATS-1 experiment were presented as video patients during the ATS-6 demonstration. Residents of Fort Yukon, Galena, and Tanana were much more likely to be presented on television than were residents of other villages. The patients' villages of residence were recorded on the monitoring log whenever possible. Table 6-3 shows the distribution for cases when the patient's village was known.

TABLE 6-2

**Ratios Between Population Age Distributions and Patient Age Distributions for Video and Audio Consultations**

| Age Group | ATS-1/ Pop. | ATS-6/ Pop. | ATS-6/ ATS-1 |
|---|---|---|---|
| 0-3 | 1.48 | .97 | .65 |
| 4-13 | .81 | .68 | .83 |
| 14-23 | .79 | .87 | 1.10 |
| 24-33 | .89 | .72 | .81 |
| 34-43 | .75 | 1.26 | 1.68 |
| 44-53 | .99 | 1.54 | 1.58 |
| 54-63 | 1.46 | 2.18 | 1.49 |
| 64 and over | 2.74 | 3.15 | 1.15 |

TABLE 6-3

Distribution of ATS-6 Consults
by Patient's Village of Residence

| Villages | Number of Cases* | Percent of Total |
|---|---|---|
| With ATS-6: | | |
| Fort Yukon | 125 | 50.0% |
| Galena | 41 | 16.4 |
| Tanana | 14 | 5.6 |
| Subtotal | 180 | 72.0% |
| Without ATS-6: | | |
| Allakaket | 8 | 3.2% |
| Anaktuvuk Pass | 1 | 0.4 |
| Arctic Village | 10 | 4.0 |
| Beaver | 1 | 0.4 |
| Chalkyitsik | 11 | 4.4 |
| Eagle | 0 | 0.0 |
| Fairbanks | 1 | 0.4 |
| Hughes | 1 | 0.4 |
| Huslia | 6 | 2.4 |
| Kaltag | 4 | 1.6 |
| Koyukuk | 3 | 1.2 |
| Nulato | 15 | 6.0 |
| Ruby | 2 | 0.8 |
| Stevens Village | 1 | 0.4 |
| Venetie | 6 | 2.4 |
| Subtotal | 70 | 28.0% |
| TOTAL | 250 | 100.0% |

*56 cases have been excluded from this analysis because of blank or inappropriate codes.

There was a strong tendency for patients from the community with the transmitter to be presented more frequently than patients from other communities. Only 28% of the cases were patients who lived in a village other than the ATS-6 villages. These villages (excluding Fairbanks, where specialist consultations are locally available) are all smaller than the ATS-6 villages, but collectively have a larger population. The ATS-6 villages contain 36% of the native population of the villages in question yet account for 72% of the cases. Patients from the ATS-6 villages were thus over-represented by twice what would be expected on the basis of population.

## 6.2 CHARACTERISTICS OF THE CASES

Approximately one in eight of the video consultations concerned a chronic ailment. The remaining television cases were evenly divided between acute problems and follow-ups of acute problems.

The video medical consultations were coded according to whether they concerned acute problems, follow-up of acute episodes, or management of chronic conditions. Valid codes were recorded in 282 cases. Of these, 43% concerned acute problems, 44% were follow-ups of acute problems, and the remaining 13% were visits for chronic ailments.

### 6.2.1 Distribution of Diagnoses

The range of diagnoses seen on ATS-6 was very wide and included even "sensitive" health problems such as genital-urinary disorders that might be expected to be absent from video consultations. The use for "sensitive" problems is very low (problems related to female genitalia and breasts, pregnancy and childbirth, birth control, and the urinary tract account for less than 2% of the cases), but they provide evidence that just about any type of case can be successfully handled in a video consult. The majority of consultations were for follow-up visits and trauma.

Diagnoses recorded for each case were divided into 26 categories, based on the major headings of the Diagnostic Code List for the Ambulatory Patient Care Report of the Indian Health Manual (Appendix III of Chapter 3 of The Indian Health Manual, TN No. 71.5, 10/5/71). Only minor adaptations have been made. Table 6-4 gives the distribution of the video consultations by diagnosis.

The bulk of the cases fall into a relatively small number of categories. The first three diagnostic categories, for follow-ups, accidents, musculoskeletal problems (usually injuries), accounted for 62% of the cases. More than 75% of the cases were accounted for by just five of the categories -- follow-ups, accidents, musculoskeletal, skin, and infective or parasitic diseases. The fact that accidents and musculoskeletal problems constituted a third of the total cases reflects the high utility of the ATS-6 consultations in cases of trauma, a surprising finding considering the three-hour-a-week schedule.

### 6.2.2 Complexity of the Cases

Almost all consults, both video and audio, concerned cases that were of minor or moderate complexity. Presentation of severe problems was very rare. Consultants were asked to judge the complexity or severity of each case, and assign it to one of the following categories:

(1) Simple question about medication, reaction, or use of household remedy, etc.

(2) Patient counseling about proper health habits, social or psychological problems.

(3) Follow-up of problem that has been under treatment.

(4) Evaluation of minor, symptomatic problems related to a particular organi system (URI, urinary tract, etc.) with little potential to become severe, or a chronic disease process with little potential for mortality.

(5) Evaluation of a moderately severe problem with potential for deterioration to severe problem or to disability, or a chronic disease process with moderate potential for mortality.

TABLE 6-4

Distribution of Diagnoses in
ATS-6 Consultations

| Diagnosis Category | Percent of Total | Number of Cases |
|---|---|---|
| Follow-ups, Supplemental Tests | 27.8% | 85 |
| Accidents | 23.9 | 73 |
| Musculoskeletal, Connective Tissue | 10.1 | 31 |
| Skin | 7.8 | 24 |
| Infective, Parasitic Disease | 6.2 | 19 |
| Respiratory | 4.6 | 14 |
| Circulatory | 4.2 | 13 |
| Digestive | 3.3 | 10 |
| Ill-defined Symptoms | 2.6 | 8 |
| Nervous System | 2.2 | 7 |
| Congenital | 1.6 | 5 |
| Ear | 1.3 | 4 |
| Mental Health | 0.9 | 3 |
| Dental | 0.7 | 2 |
| Endocrine, Nutritional, Metabolic | 0.7 | 2 |
| Female Genitalia & Breast | 0.7 | 2 |
| Pregnancy, Childbirth, Puerperium | 0.3 | 1 |
| Birth Control | 0.3 | 1 |
| Eye | 0.3 | 1 |
| Urinary | 0.3 | 1 |
| TOTAL | | 306 |

(6) Evaluation of a severe problem of life threatening proportions or potential disability, or a chronic disease process with high potential for mortality.

The results are presented in Table 6-5. A slightly higher proportion of video cases was spent on follow-ups, and a much higher proportion was spent discussing moderately severe problems. Fewer video cases dealt with "minor symptomatic problems." "Severe" problems occurred very rarely; none of the video encounters and only one of the audio encounters was coded as "6". This may be because the consultants are too busy in severe cases to fill in the form completely, and hence under-report the severe cases. The differences between video and audio, while moderate, were statistically quite significant (Chi-square = 34.7, df = 5, $p<.01$).

## 6.3 SUITABILITY OF CASES FOR AUDIO AND VIDEO CONSULTATION

Audio and video consultations seemed to have different strengths but similar weaknesses. Audio consults were especially good for routine care, while video consults were preferred for subjective kinds of exams. Neither medium was good for personally sensitive cases. Health care providers who were involved in the demonstration were asked in post-experimental interviews what types of cases were especially suitable for and especially difficult for both radio and television consultations. Table 6-6 summarizes the types of cases they mentioned, and the figure in parentheses after the type of case indicates the number of times it was mentioned.

There was more similarity between audio and video for difficult cases than for convenient cases. Personally sensitive cases or those involving alcoholism or dermatology are cited as difficult to handle through either medium. Paradoxically, dermatological cases are cited as both convenient and difficult for television consultation. This may be a result of the fact that



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TABLE 6-5

Complexity-Severity of Video and Audio Teleconsultations

| Category | Number of Cases* | | Percent of Coded Cases | |
|---|---|---|---|---|
| | Video | Audio | Video | Audio |
| 1. Simple Question | 3 | 30 | 1.3% | 2.0% |
| 2. Patient Counseling | 3 | 4 | 1.3 | 0.3 |
| 3. Follow-up | 16 | 72 | 7.1 | 4.8 |
| 4. Evaluation of Minor, Symptomatic Problem | 175 | 1335 | 77.4 | 88.4 |
| 5. Evaluation of Moderately Severe Problem | 29 | 69 | 12.8 | 4.6 |
| 6. Evaluation of a Severe Problem** | 0 | 1 | 0.0 | 0.1 |

*226 of the 319 video cases and 1,511 of the 1,778 audio cases were coded and are used in this analysis.

**The very low frequency of severe cases may reflect the fact that with severe medical problems, the physician is too busy to fill in the form completely.

TABLE 6-6

Conditions Cited as Especially Convenient or Difficult for Teleconsultation

| Convenient for Audio Consultations | Convenient for Television Consultations |
| --- | --- |
| Acute illness, e.g., URI, otitis media, diarrhea (14)<br>Patient management planning (3)<br>Emergencies (2)<br>Chronic problems (1)<br>Obstetrics (1)<br>Routine pediatrics (1)<br>Making travel decisions (1) | Orthopedic cases (5)<br>Trauma (4)<br>X-rays (3)<br>Highly subjective exams (3)<br>Neurological exams (1)<br>Well-baby exams (1)<br>Dermatology (2)<br>Patient motivation (1) |
| **Difficult for Audio Consultations** | **Difficult for Television Consultations** |
| Personally sensitive cases, e.g., psychiatric, V.D., genital-urinary (9)<br>Highly subjective exams (5)<br>Alcohol-related problems (1)<br>Orthopedics (1)<br>Eye problems (1)<br>Dermatology (1) | Personally sensitive cases, e.g., psychiatric, V.D., genital-urinary (6)<br>Dermatology (1)<br>Exams requiring lab tests (1)<br>Acute alcoholism (1)<br>Uncooperative patients (1) |

while dermatological consults may be difficult with video, they are much easier with video than with audio-only.

## 6.4 SUMMARY

The patients and the types of complaints encountered during the ATS-6 demonstration were remarkable for their diversity. The patients came from every age bracket and practically every community in the Tanana Service Unit. Diagnoses were also widely represented, although the majority could be accounted for in follow-up visits and visits necessitated by an accident. Cases seen on television seemed to be slightly more complex or severe than those presented over the satellite radio. Difficult cases for video were also difficult for audio-only consultation.



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## CHAPTER SEVEN

## EFFECTS ON THE PROCESS OF MEDICAL CARE

The introduction of video teleconsultation services might alter the process of medical care in a variety of ways, not all of which would necessarily be beneficial. This chapter examines the changes that resulted from teleconsultations along such parameters as the diagnosis of the complaint, the change in management plans, and changes in procedure because of the video consulting situation.

### 7.1 CHANGES IN DIAGNOSIS

Almost all consultations either confirmed the local provider's diagnosis or made a minor change. Differences between video, audio, and telephone consults in rate of diagnosis change were very small and seemed to be the result of differences in the skill levels of the providers using each medium.

Consultants and the monitoring physicians were asked to record what change in the local provider's original diagnosis resulted from the consultation. They used a three-point scale, ranging from "1" for "confirmed local provider's diagnosis" through "2" for "made minor changes" to "3" for "made significant changes." These records were kept for all consultations, regardless of the medium used. Table 7-1 shows the distribution of changes in diagnosis for different media of consultation.

To control for seasonal variations, the data presented in these and subsequent tables refer only to the period when video consultations were fully operational, i.e., from September 17, 1974 to May 16, 1975.

The local provider's assessment was confirmed in the great majority of cases. The overall rate of diagnosis change was highest for video consults. Telephone consults led to diagnosis changes about four-fifths as often as video consults. Audio

TABLE 7-1

**Percentages of Cases Having a Given Diagnosis Change Code, Calculated from HIS Records for Each Medium of Consult**

| Medium of Consultation | Diagnosis Change Code | | |
|---|---|---|---|
| | Confirmed | Minor Change | Major Change |
| Video (N = 221) | 63.3% | 34.8% | 1.8% |
| Audio (N = 1456) | 82.1% | 17.4% | 0.5% |
| Telephone (N = 44) | 70.5% | 29.5% | 0.0% |

consults resulted in diagnosis changes only half as often as video. Minor changes were made in about one-third of the television cases and one-sixth of the audio. Only rarely did consultations lead to major changes in the diagnosis of the local providers.

The differences between video and audio in diagnosis changes are highly significant statistically (Chi-square equals 43.4, df = 2, $p<.01$).

In analyzing these results, it must be remembered that there were major differences between the training of the personnel involved, the types of cases selected, and the availability of each medium. Almost all of the audio consultations were between community health aides and a doctor; very few of the video or phone consults involved health aides. One might reasonably expect that health care providers with higher levels of training and experience would have higher levels of confirmation than the health aides, or that highly trained providers might seek consultation only in more complicated cases and might actually have a lower level of confirmation than less sophisticated health aides.

In addition, it was shown in Chapter 6 that the cases presented over video were slightly more complex than those discussed over the ATS-1 satellite. Thus it is not surprising that the proportion of cases with changed diagnosis was higher for video than audio, but this result is difficult to interpret. One cannot conclude from these figures that these differences were due to any difference between the inherent capabilities of the media, because of the variations in kinds of cases and providers' levels of training.

A limited amount of data was available from the HIS data base on telephone consultations. Of the ATS-1 villages, only Fort Yukon, Galena, and Tanana have telephones. The distribution of diagnosis change codes for telephone consultations is also shown in Table 7-1. A few of the telephone consults were from non-ATS-1 communities that have telephones, but the majority were from the health care providers in Fort Yukon and Galena. The

pattern of diagnosis changes displayed in the telephone consultations lies between the patterns for video and audio, but is more similar to video.

A Chi-square calculated for all three media taken together is significant (Chi-square = 46.0, df = 4, $p < .01$); however, Chi-squares calculated on comparisons of audio with telephone and video with telephone are not significant. (Audio with telephone: Chi-square = 4.5, df = 2, $.05 < p < .1$); video with telephone: Chi-square = 1.38, df = 2, $p < .5$).

The only significant difference between pairs of media is between audio, although the difference between audio and telephone is very close to being significant. Thus, video and telephone are very similar and audio is different from both of them. This finding suggests that the differences between media in diagnosis change really reflect the skill levels of the providers and the types of cases presented, rather than any differences between the media in capacity to convey information about a patient's health problem.

Second and third sources of data on the diagnosis changes in video teleconsultations came from the monitoring logs filled out by a physician at Anchorage, and by a medical student at Tanana. The distributions of diagnosis changes according to these sources were quite different from the distribution reported by the doctors at Tanana. Table 7-2 compares the distributions of diagnosis change codes reported by the three sources.

The difference shown in the Anchorage monitoring log is most striking. The majority of the cases were coded as "minor change" rather than as "confirmed" as in the other two sources. Nearly a quarter of the cases coded on the Anchorage monitoring logs were classed as "major change," compared to almost none of the HIS cases.

A number of factors that might explain these discrepancies make acceptance of the HIS data the most reasonable choice. The users of the Anchorage and Tanana monitoring logs had never

TABLE 7-2

Distribution of Diagnosis Change in Video Consultations, Reported by Various Sources

| Source of Data | Diagnosis Change Code | | |
|---|---|---|---|
| | Confirmed | Minor Change | Major Change |
| HIS Forms (N = 221) | 63.3% | 34.8% | 1.8% |
| Anchorage Monitoring Log (N = 225) | 12.9% | 62.2% | 24.9% |
| Tanana Monitoring Log (N = 31) | 51.6% | 32.3% | 16.1% |



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encountered these codes before, while the physicians at Tanana filling out the HIS forms had been using these codes for some time (even prior to the introduction of the HIS system, for ATS-1 Doctor Call). Coding of several doctors was combined in the "HIS form" row, while each monitoring log was essentially the work of one person. The doctors at Tanana were also more familiar with the personalities and capabilities of the local health care providers in Fort Yukon and Galena. Finally, the doctors at Tanana were participants in the consultation, actually making the diagnosis changes they coded, while the other coders were usually observers of the consult.

## 7.2 CHANGES IN MANAGEMENT PLAN

About half of all consultations resulted in a change in the management plan proposed by the local provider. There was no difference between media in rate of management change.

Physicians and observers rated changes in the management plan resulting from the consultation, using the same codes as for diagnosis change. The physicians at Tanana rated the management changes resulting from all their teleconsultations, including video, audio, and telephone. Table 7-3 shows the distributions of their management change ratings.

The consultants made no change in management plan slightly over half the time, minor changes roughly 40% of the time, and major changes only 2 to 4% of the time. The levels of minor and major changes in management were higher than the levels of changes in diagnosis; it appears that the consulting physicians were adjusting the management course of the local provider even when they agreed with the diagnosis.

The patterns of change in the local providers' original management plans are very similar across all media. A Chi-square test for differences among the media strongly indicates no difference (Chi-square = 2.68, df = 4, $p<.7$). Thus none of the communication media led to any differences in the level of management change by consulting physicians.

TABLE 7-3

Distribution of Management Change Codes in Video Consultations, Reported in HIS Records for Each Medium of Consultation

| Medium of Consultation | Management Change Code | | |
|---|---|---|---|
| | Confirmed | Minor Change | Major Change |
| Video (N = 217) | 53.9% | 43.8% | 2.3% |
| Audio (N = 1413) | 56.6% | 39.5% | 3.9% |
| Telephone (N = 44) | 59.1% | 36.4% | 4.5% |



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Management change codes for video were also recorded on the Anchorage and Tanana monitoring logs. Tabulations for each data source are shown in Table 7-4. The very large differences in the coding patterns were similar to those observed between these same data sources on diagnosis changes. The monitoring physician at Anchorage felt that many more changes in management plan were made than did either of the other two sources. The observer at Tanana agreed with the physicians involved in the consultations on the number of times changes were made, but classed many more of the changes as major.

Again, the interpretation of these differences is a complex matter. For the same reasons cited in Section 7.2 (greater experience with the codes, greater familiarity with the people involved, aggregate results based on several physicians coding and greater involvement with the consultation), the HIS code distribution seems the most likely one to accept as a standard.

## 7.3 RELATIONSHIPS BETWEEN COMPLEXITY OF THE CASE, DIAGNOSIS CHANGE, AND MANAGEMENT CHANGE

One would expect the proportions of changes in diagnosis and management to be higher among the more complex cases, and this, in fact, occurred. Table 7-5 shows the relationship of the complexity of the case to the diagnosis changes for video teleconsults. Almost no changes occurred among the simplest cases. About one follow-up visit in seven resulted in a minor diagnosis change. Among minor problems, about one case in three resulted in a minor change in diagnosis. Among moderately severe problems, about two cases in three resulted in changes.

Table 7-6 presents the relationship between management change and the complexity of the case for video consultations. Here, one follow-up in three led to a minor change in management. The rate of management change for minor problems was roughly two in five, and roughly three out of four among the moderately severe problems.

TABLE 7-4

**Distribution of Management Change Codes in Video Consultations, Reported by Various Sources**

| Source of Data | Management Change Code | | |
|---|---|---|---|
| | Confirmed | Minor Change | Major Change |
| HIS Forms (N = 217) | 53.9% | 43.8% | 2.3% |
| Anchorage Monitoring Log (N = 225) | 11.1% | 61.8% | 27.1% |
| Tanana Monitoring Log (N = 39) | 56.4% | 20.5% | 23.1% |

TABLE 7-5

**Distribution of Video Consultations of Different Complexity Among Categories of Diagnosis Change, Calculated from HIS Records***

| Diagnosis Change Code | Complexity of Case | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Simple Question | Patient Counseling | Follow-up Visit | Minor Problem | Moderate Problem | Severe Problem | |
| Confirmed | 0.9% | 0.9% | 6.4% | 51.6% | 4.1% | 0.0% | 63.9% |
| Minor Change | 0.0% | 0.0% | 0.9% | 25.6% | 7.8% | 0.0% | 34.3% |
| Major Change | 0.0% | 0.5% | 0.0% | 0.5% | 0.9% | 0.0% | 1.9% |
| Total | 0.9% | 1.4% | 7.3% | 77.7% | 12.8% | 0.0% | |

*The number of HIS video teleconsultation records having both complexity and diagnosis change codes is 219.



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TABLE 7-6

Distribution of Video Consultations of Different Complexity
Among Categories of Management Change, Calculated from HIS Record*

| Management Change Code | Complexity of Case | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Simple Question | Patient Counseling | Follow-up Visit | Minor Problem | Moderate Problem | Severe Problem | |
| Confirmed | 0.5% | 0.9% | 4.6% | 44.5% | 3.2% | 0.0% | 53.7% |
| Minor Change | 0.5% | 0.5% | 2.3% | 32.1% | 8.7% | 0.0% | 44.1% |
| Major Change | 0.0% | 0.0% | 0.0% | 0.9% | 1.4% | 0.0% | 2.3% |
| Total | 1.0% | 1.4% | 6.9% | 77.5% | 13.3% | 0.0% | |

*The number of HIS video teleconsultation records having both complexity and management change codes is 218.



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The relationship between diagnosis change and management change was also about what one would expect. Table 7-7 gives the distribution of video consults among combinations of diagnosis and management change. In almost half the total cases, no change was made in either diagnosis or management. When any change was made in diagnosis, a change was made in management about three-quarters of the time. When no change was made in diagnosis, the management plan was still changed about one-quarter of the time.

## 7.4 ROLE PLAYED BY VIDEO CAPABILITY

After an initial enthusiasm for video has abated, is appears that the visual component makes a critical contribution to the consultation in about 5% of the cases selected for video consults.

In an attempt to measure directly the importance of the addition of video to the audio-only consultations, the physician and the medical student at Anchorage and Tanana, respectively, were asked to complete an item answering the question, "Was video different than audio-only would have been?" for each video teleconsultation. The codes for the item were:

"1" The picture was absolutely critical to the consultation.

"2" Video was much better than audio-only.

"3" Video was slightly better than audio-only.

"4" There was no difference between video and audio-only.

"5" Video was worse than audio-only.

The results of their ratings are presented in Table 7-8. There is a considerable difference between the two monitors' ratings, but the actual disparity between the distributions was even larger. The Anchorage monitoring log covered the entire demonstration, but the Tanana monitoring log covered only the last month of the demonstration period. During the last month, the observer at Tanana coded 14 cases as "absolutely critical";

TABLE 7-7

Distribution of Video Consultations of Different Diagnosis Change Codes Among Categories of Management Change Code, Calculated from HIS Records*

| Management Change Code | Diagnosis Change Code | | | Total |
|---|---|---|---|---|
| | Confirmed | Minor Change | Major Change | |
| Confirmed | 45.2% | 8.3% | 0.5% | 54.0% |
| Minor Change | 17.0% | 25.8% | 0.5% | 43.3% |
| Major Change | 0.5% | 1.4% | 0.9% | 2.8% |
| Total | 62.7% | 35.5% | 1.9% | |

*The number of HIS video teleconsultation records having both diagnosis and management change codes is 217.



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TABLE 7-8

Distribution of Video Consultations According to the Comparison of Video with a Hypothetical Audio-only Consult for the Same Case

| Source of Data | Importance of Video | | | | |
|---|---|---|---|---|---|
| | Absolutely Critical | Much Better | Slightly Better | No Different | Worse |
| Anchorage Monitoring Log (N = 216) | 10.6% | 72.2% | 13.0% | 4.2% | 0.0% |
| Tanana Monitoring Log (N = 47) | 29.8% | 40.4% | 17.0% | 12.8% | 0.0% |

for the same period, the observer at Anchorage coded only two cases as "absolutely critical."

Because they were viewing the same consultations, it is clear that the two monitors were using the codes in different ways. Examination of the cases each coded as critical bears this out. Of the 14 cases coded critical on the Tanana log, there were nine cases in which X-rays were viewed, 10 cases in which close-up shots were used (including seven of the cases where X-rays were shown), three cases in which the doctor directed the patient to perform special maneuvers for remote observation, and one case in which an EKG was transmitted. Most of these cases involved features that could not be performed without television, but there is no evidence that their use was critical to the outcome of the consultation.

Both of the two cases coded critical by the Anchorage monitor involved trauma. One of these involved an automobile accident, the other a snowmobile accident. In both cases, the critical role played by the television was in avoiding unnecessary transportation of patients to the hospital. In these cases, the content conveyed by the picture was critical to resolving the consultation.

The potential of video to make possible a decision that otherwise could not have been made constitutes a strong argument for the value of video consultations. A stable estimate of the proportion of video consults in which the video capability really played a critical role would be valuable for assessing the need for such a system. The disparity between the Anchorage and Tanana monitoring log estimates of the proportion of cases (10% versus 30%) led to deeper investigation of those cases. The proportion of cases classed as critical during the early months of the Anchorage monitoring log was much higher than the proportion during the later months. Evidently, in the beginning the novelty of the television led to a high estimation of its value. The proportions of critical cases in the Anchorage logs fell fairly steadily from 60% in the first month to 3% in the last month.

The data for the Tanana monitoring log represent that observer's first month of exposure to video and his rating of 30% of the cases as critical is consistent with the early months' performance by the other coder.

Data from the Anchorage logs were divided into first and second halves of the demonstration, in order to get an estimate that was somewhat free of "early enthusiasm" for the video. The proportion of critical cases during the first half was 23%; the proportion in the second half was 5%. Thus, it seems that a reasonable estimate of the proportion of video consultations (a more complex subset of the overall consultation load) in which the video capability plays a critical role is about 5%.

## 7.5 DECISIONS ABOUT PATIENT TRAVEL

One possible benefit of a video consultation system is the reduction of patient travel to see doctors. Stress and inconvenience to the patients would be reduced, and the money saved in avoided travel might help offset the cost of the video system.

In this demonstration, roughly one video consult in six led to travel for the patient. Good data for audio consults were not available.

Codes were added to the HIS teleconsultation for the consultants to record, for each case in which travel was considered, the source of the request and the disposition of the request. The codes for source of the request were:

"1" Request from patient
"2" Request from primary provider
"3" Request from consultant

The codes for the disposition of the request were:

"1" Not authorized
"2" Authorized, routine priority
"3" Authorized, urgent priority

Routine priority generally indicated that the patient should travel on the next scheduled flight, and an urgent priority meant that a plane would be chartered to bring the patient in to the hospital. However, the incidence of recording was quite low (only 6% of the cases have recorded codes). The lack of a recorded code was supposed to have indicated that travel was not considered. However, other data sources indicate that travel was actually considered in approximately 18% of the cases, or three times the level shown in the HIS records. Because of the low response rate, these figures are difficult to interpret, and may even be misleading. Hence, they are not presented here.

In order to get a more reliable estimate of the travel decisions, the Anchorage monitoring logs were reviewed to see whether a determination about patient travel could be made. In 93% of the cases, it was possible to code the travel disposition of the case. The codes used were:

"1" Travel not considered
"2" Travel considered, not authorized
"3" Travel authorized, routine priority
"4" Travel authorized, urgent priority
"5" Travel authorized, priority unknown

Table 7-9 presents the percentages of the codable cases that fell into each category. Codes 1 and 2 have been collapsed together. There was no patient travel in more than 80% of the cases. Travel was authorized in a total of 17% of the cases, and considered but not authorized less than 1% of the time.

## 7.6 EFFECTS OF THE DEMONSTRATION SITUATION ON THE PROCESS OF MEDICAL CARE

Operational aspects of the demonstration environment sometimes intruded into the process of giving medical care. This section discusses some of the more general comments that participants made during interviews about the system. Most of the

TABLE 7-9

Distribution of Video Cases Among Different Categories of Patient Travel Decisions, Coded From the Anchorage Monitoring Logs

| | No Patient Travel | Authorized, Routine | Authorized, Urgent | Authorized, Priority Unknown |
|---|---|---|---|---|
| Number of Cases (N = 286) | 237 | 3 | 6 | 4 |
| Percent of Codable Cases | 82.9% | 1.0% | 2.1% | 14.0% |

comments concerned time constraints, the high level of organization required, and difficulties in using the equipment. The most widely raised complaints about the structure of the demonstration concerned the time constraints imposed by the satellite schedule. The time limitations led to a number of problems. Since the satellite was available only three times a week for one hour, any serious acute cases that did not arrive shortly before a satellite time block had to be dealt with by telephone and ATS-1 in the traditional ways. Many providers explicitly mentioned that if the system had been available on demand, they would have been able to make much better use of it. As it was, even for cases that were stable enough to delay a consult until the next ATS-6 transmission, the patients had to be induced to return to the clinic at a specific time and date for presentation, which was not always easy to accomplish.

A corollary of the schedule constraints problem was that there was both too much and too little time available. Providers noted that some consultations were either cut off prematurely or not begun because only a few minutes of scheduled time remained. They also resented the feeling of obligation to fill the available satellite time with medical traffic, even if they did not have any cases they felt were appropriate for presentation. This constraint sometimes led to presentations of cases that the local providers perceived as routine, but that consulting specialists reviewed in a fairly conservative manner. The mismatch between the perceptions of the severity of the cases at different sites produced some feelings of resentment, as if "Big Brother" were monitoring one's daily practice, rather than being available to assist when called upon. As a procedural matter, confusion sometimes arose as to who was directing a consultation when, as often happened, the physicians at Tanana and the specialist at Anchorage were both actively involved in a consultation.

Similar schedule constraints could pose problems for an operational system, depending on how access was arranged. Clearly,

on-demand availability would be a high priority among providers.

A second major comment about the structure of the demonstration was that a very large amount of advance coordination and preparation was required to make things function smoothly. The tasks ranged from contacting all sites prior to the transmission to determine what specialists were required at Anchorage and what records had to be pulled, to removing bandages from wounds, mounting X-rays and EKGs, etc. Without extremely dedicated participation of the small staff involved in this demonstration, the level of coordination required for successful operation of the project might never have been reached.

Other problems related to the specific situation of the demonstration that were mentioned less frequently by the providers included difficulty in communicating directly with patients, irritation at dealing with the equipment, lack of privacy, and a number of demonstration-related visitors they had to deal with.

Most patients seemed to be quite comfortable with being presented on camera, although a significant number seemed unwilling to talk on the microphone. Many said in interviews that they did not really understand who was watching them or why they were being presented, in spite of diligent efforts by the staff to explain the system to them. The consultants often felt that it was not really necessary to talk directly to the patients because the case could be more efficiently presented by the local provider. This probably contributed to patients feeling ill-at-ease.

The equipment was often singled out for comment. Most of the rooms used for video presentations were quite small and not particularly well-suited for television presentations. Addition of the equipment made them very cramped; attempts to alleviate the space problem by locating some of the equipment in another room caused other inconveniences. Some of the problems were solved when the remote control apparatus was installed on the cameras, thus freeing the local provider from having to adjust the camera while presenting the patient. One persistent irritant was that

the ATS-6 set-up did not provide an automatic cut-off of one of the two microphones while the other was in use. When, for example, the physician at Tanana was speaking over ATS-1, his voice was picked up by the ATS-6 microphones and came back with a half-second delay over the ATS-6 speakers. Such an echo is very difficult to talk past, and provisions had to be made for a second person the turn manually the controls of the speakers up and down as different people spoke. That procedure helped, but it, in turn, led to difficulties when the controls were not changed quickly enough and things had to be repeated.

The lack of privacy problem was similar to the one encountered on ATS-1, except that more people were involved and the patient was more often present. The Tanana physicians and Anchorage specialists sometimes had to defer discussions about patients until later phone calls. This was the case, for example, in discussing a patient's suitability for insulin therapy, when the patient was not considered a good candidate because of a drinking problem. On another level, privacy problems required that the clinics at Fort Yukon and Galena be closed during the satellite transmission to maintain an appropriate level of confidentiality, because the staff could not handle video patients and other patients simultaneously.

## 7.7 SUMMARY

There seemed to be few major differences in the process of medical care in video teleconsultations. The diagnosis seemed to be changed more frequently than in audio consultations, but when the comparison was controlled for level of skill of local providers, the difference seemed to disappear. The level of change in management plan was the same as for audio consultations. As would be expected, most of the major changes were in the most complex cases, and more management change was seen when there was a diagnosis change than when there was not. Visual information played a critical role in about 5% of the cases selected for video

consultations. Patient travel resulted from about 17% of the video consultations. The structure of the video consultation, and particularly of the time constraints imposed by the rigid satellite schedule, caused some problems for the providers and patients.



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## CHAPTER EIGHT

## EFFECTS ON MEDICAL OUTCOMES

A measurement of the effect of the consultation on the patient's health status is the ideal yardstick by which to judge the value of the consultation service. If the changes in diagnosis and management resulting from consultations over the various communication channels had no ultimate effect on the outcome for the patient, there would be little value in continuing the consultations. The physicians were asked to estimate the effects of the consultation on the long-term outcome for each consultation in which they participated. The codes used were:

- "1" No effect on eventual outcome
- "2" Some effect, probably only relative to symptoms, not affecting future disability
- "3" Definite effect related to future well-being or prevention of disability
- "4" Marked effect, possibly lifesaving, or prevention of major disability

These codes were to be recorded by the Tanana physicians on the HIS teleconsultation forms for every video, audio, and telephone consult for which they filed a patient record. They were also contained on the Anchorage and Tanana monitoring logs, and recorded for each video consult.

### 8.1 COMPARISON OF OUTCOMES FOR DIFFERENT MEDIA

There was no difference in outcome for the patient between video, audio, or telephone consults. The results of the ratings for each medium by the physicians at Tanana are presented in Table 8-1. The physicians judged that their interventions would have no effect or only symptomatic effect in roughly half of the cases. The effect would be marked, possibly life-saving, in two

TABLE 8-1

Distribution of Cases Among Categories of Outcome, for Each Medium of Consultation, From HIS Records

| Medium of Consult | Outcome Code | | | |
|---|---|---|---|---|
| | No Effect | Some Effect, Symptomatic | Definite Effect | Marked Effect, Poss. Life-saving |
| Video (N = 211) | 5.7% | 42.6% | 48.4% | 3.3% |
| Audio (N = 1309) | 9.5% | 46.5% | 42.3% | 1.8% |
| Telephone (N = 42) | 2.4% | 42.8% | 52.4% | 2.4% |

or three percent of the cases, and the remainder of the cases would show a definite effect. The proportions of the cases that would show substantial effects from the consultation were reassuringly high.

The pattern displayed for each medium is quite similar. A Chi-square test measuring differences among the media is not significant (Chi-square = 10.22, df = 6, p<.2). There was thus no difference among the three media -- video, audio, and telephone -- in the amount of outcome change resulting from the consultations. None of the pairwise comparisons (of video with audio, audio with telephone, and video with telephone) show any significant differences.

## 8.2 COMPARISON OF OUTCOME RATINGS BY DIFFERENT RATERS

There are two additional sources of outcome code data. The physician monitoring the video transmissions rated the video for each consult she observed, and in the last month of the demonstration the medical student at Tanana rated the outcome for each video consultation he observed. Table 8-2 shows the proportion of cases that each rater assigned to the different outcome categories. The pattern shown on the Anchorage monitoring log is very close to that shown by the HIS cases. The pattern shown by the distribution of codes from the Tanana monitoring log is very different from the other two. That rater classified only about 25% of the cases as having a definite or marked effect, while the other coders classed about 50% of the cases in these two categories.

In fact, tests for differences between the various pairs of raters show that the Anchorage monitoring log and the HIS records are not different (Chi-square = 3.26, df = 3, p<.5), but that the Tanana monitoring logs are different from both the HIS records and the Anchorage monitoring logs (Chi-square = 41.41, df = 3, p<.01, and Chi-square = 51.08, df = 3, p<.01, respectively). The facts that the Tanana monitoring logs cover only the last month of consultation, that the coder was new to the codes at

TABLE 8-2

Distribution of Video Cases Among Different Outcome Code Categories, According to Three Different Raters

| Source of Data | Outcome Code | | | |
|---|---|---|---|---|
| | No Effect | Some Effect, Symptomatic | Definite Effect | Marked Effect, Poss. Life-saving |
| HIS Records (N = 211) | 5.7% | 42.6% | 48.4% | 3.3% |
| Anchorage Monitoring Log (N = 211) | 3.8% | 43.6% | 46.0% | 6.6% |
| Tanana Monitoring Log (N = 41) | 39.0% | 36.6% | 19.5% | 4.9% |

that time, and that he had considerably less medical experience than the other coders incline one to place more confidence in the other coders' judgments.

## 8.3 RELATION OF OUTCOME CODES TO COMPLEXITY, DIAGNOSIS CHANGE, AND MANAGEMENT CHANGE

The more complex the case or the greater the change in diagnosis or management as a result of the consultation, the more effect the consultation will have on the ultimate outcome for the patient.

Table 8-3 shows the relationship between the complexity of the case and the effect of the consultation on the outcome for video cases. Almost all the cases fall into the "follow-up visit-minor problem-moderate problem" range of the complexity code. If the outcome codes are divided into two halves, i.e., "symptomatic or no effect" and "definite or marked effect," then follow-up visits and minor problems are roughly evenly split between the two. The "moderate problems," however, are heavily concentrated in the "definite or marked effect" half. More than three-quarters of the "moderate problems" have received the higher outcome ratings. Not surprisingly, patients with more complex problems are likely to benefit more from consultations.

The relationship between changes in the diagnosis by the consultant and effects on the outcome is shown in Table 8-4. If the outcome codes are divided into the same two halves as before, it is easily seen that the greater the change in diagnosis, the greater will be the rated effect of the consultation. Less than half (about 45%) of the "confirmed" cases have "definite or marked effect" codes, but about two-thirds of the "minor change" cases, and all of the very few "major change" cases, fall into the upper outcome categories.

Finally, Table 8-5 shows the relationship of outcome codes to management change codes. These data show a similar and plausible relationship; greater amounts of outcome change are likely to be



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TABLE 8-3

Distribution of Video Consultations by Complexity and Outcome Codes, Calculated from HIS Records and Expressed as a Percentage of Coded Cases*

| Complexity of Case | Outcome Code | | | | Total |
|---|---|---|---|---|---|
| | No Effect | Some Effect, Symptomatic | Definite Effect | Marked Effect, Poss. Life-saving | |
| Simple Question | 0.5% | 0.0% | 0.5% | 0.0% | 1.0% |
| Patient Counseling | 0.5% | 0.5% | 0.0% | 0.0% | 1.0% |
| Follow-up Visit | 0.5% | 2.8% | 3.8% | 0.0% | 7.1% |
| Minor Problem | 3.8% | 37.0% | 34.6% | 2.8% | 78.2% |
| Moderate Problem | 0.5% | 2.4% | 9.5% | 0.5% | 12.9% |
| Severe Problem | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 5.8% | 42.7% | 48.4% | 3.3% | |

*The number of video HIS records having both complexity and outcome codes is 211.

TABLE 8-4

Distribution of Video Consultations by Diagnosis Change and Outcome Codes, Calculated from HIS Records and Expressed as a Percentage of Coded Cases*

| Diagnosis Change Code | Outcome Code | | | | Total |
|---|---|---|---|---|---|
| | No Effect | Some Effect, Symptomatic, | Definite Effect | Marked Effect Poss. Life-saving | |
| Confirmed | 5.6% | 29.4% | 25.2% | 1.9% | 62.1% |
| Minor Change | 0.0% | 12.6% | 22.9% | 1.4% | 36.9% |
| Major Change | 0.0% | 0.0% | 0.9% | 0.0% | 0.9% |
| Total | 5.6% | 42.0% | 49.0% | 3.3% | |

*The number of HIS video records having both outcome and diagnosis change codes is 214.

TABLE 8-5

Distribution of Video Consultations by Management Change and Outcome Codes, Calculated from HIS Records and Expressed as a Percentage of Coded Cases*

| Management Change Code | Outcome Code | | | | Total |
|---|---|---|---|---|---|
| | No Effect | Some Effect, Symptomatic | Definite Effect | Marked Effect, Poss. Life-saving | |
| Confirmed | 5.2% | 28.4% | 20.4% | 0.5% | 54.5% |
| Minor Change | 0.5% | 10.9% | 25.1% | 1.9% | 38.4% |
| Major Change | 0.0% | 3.3% | 2.8% | 0.9% | 7.0% |
| Total | 5.7% | 42.6% | 48.3% | 3.3% | |

*The number of HIS video records having both outcome and management change codes is 211.

coded for greater management changes. The pattern is stronger here than in the diagnosis change codes. Less than 40% of the "confirmed" management codes fall in the upper half of the outcome range (compared to about 45% for diagnosis change codes). More than 70% of the "minor change" cases fall in the upper half (compared with about two-thirds for the diagnostic change codes). About half of the "major change" cases fall into the upper range of outcome codes (compared to all of the "major change" diagnosis codes), but the numbers involved in this category are so small that their interpretation is difficult. Only two cases were given diagnosis codes of "major change"; the proportions we are describing here might shift drastically if only one or two cases were added to that row. The "major change" row in the management change table is composed of 15 cases. The proportions calculated on this base are slightly more stable, but still too sensitive to permit much confidence.

## 8.4 SUMMARY

Ratings by the doctors involved in the consultations of the effect that the consultation would have on the eventual health status of the patient showed that about half of all consultations would have a more-than-symptomatic effect. These ratings showed no difference between video, audio, and telephone consultations in the extent that they affect the patient's eventual health status.

More complex cases were coded as being more affected by the consultation. Consultations in which the consultant made changes in the diagnosis and management plan of the local provider were coded as having greater effects on the patient's long-run health status than consultations in which the local diagnosis and management plan were confirmed.

## CHAPTER NINE

## ATTITUDES OF USERS

Video teleconsultation was an innovation introduced into an environment of real and conflicting needs in both health care and social change. Attitudes of "users," that is, both health care providers and consumers, were investigated to determine what they felt their needs to be, how they reacted to the current health care system, and how well they felt the ATS-1 and ATS-6 based medical communication programs were meeting those needs.

The information reported in this chapter comes primarily from several series of interviews that were conducted before and after the experiment. Thirteen health care providers were interviewed before and after the demonstration (provider interviews); eight members of the Satellite Review Committee and other native leaders were interviewed (consumer interviews); and six specialists at Anchorage who consulted over the system were interviewed after the demonstration (consultant interviews). Some comparative data is incorporated from a 1974 study on federal programs and Alaskan natives, carried out by Robert R. Nathan Associates, called the "2-C" study after the section of the Lands Claim Act that authorized it (<u>Federal Programs and Alaska Natives</u>, 1975).

### 9.1 PERCEIVED NEEDS IN HEALTH CARE AND OTHER AREAS

Providers and consumers identified alcoholism and mental health as the main health and community problems. Most felt that these problems were not being handled satisfactorily. More health education programs were thought necessary. Improved telephone service was cited as the greatest communication need.



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9.1.1 Health Problems

As a part of a general assessment of the health situation in rural Alaska, providers were asked what conditions they saw most frequently, and what were the major health problems in their area. The most frequently encountered condition was, by a very wide margin, the general category of upper respiratory infections (URI), colds, and sore throats. The conditions mentioned by a significant number of providers are listed below with the summed rank-weight in parentheses.

URI, cold, sore throat (25)
Maternal, newborn, and child health problems (9)
Infectious diseases, otitis media, skin problems (9)
Alcoholism and alcohol-related problems (8)
Trauma, injuries, and accidents (7)
Chronic follow-up (3)
Family planning, V.D., sex-related problems (3)

However, when asked to name the most important health problem, ten providers responded with alcoholism and alcohol-related problems. The list below gives the conditions and summed rank-weights of the most important problems identified by the providers.

Alcoholism and alcohol-related problems (26)
Colds (6)
Mental health and adolescent psychological problems (5)
Poor municipal sanitation services (3)
Tuberculosis (3)

None of the respondents who mentioned alcoholism felt that the problem was being satisfactorily handled. They replied, in general, that alcoholism was a social problem and they didn't know what could be done about it.

When asked what they thought the community viewed as the main health problems, the providers named alcoholism first and mental health second. Other problems mentioned were infectious disease, tuberculosis, and "underskilled providers."

In interviews with consumers, two-thirds of the respondents said that alcoholism was the major health problem. Other "health"

problems that were mentioned were venereal disease, poverty, overcrowded homes, poor communication between providers and patients, and lack of health education. Generally, they felt that the major health problems were social in nature, and reflected the tremendous pressures of a culture in rapid transition.

Five of the six consumers interviewed felt the problems they named were not being handled satisfactorily. Educational campaigns on alcoholism and VD were suggested. A general need for more trained staff and native staff was expressed, and more meetings between the providers and community were called for. One respondent said that the Tanana Health Authority was trying to re-orient the system to respond to input from the consumer's end.

In the 2-C study, native families were asked: "What health care do you and your family need that you are not getting?" The responses were roughly similar to those obtained in these interviews. The top five responses were dental care, alcohol care, eye-ear-nose-and-throat care, a local clinic, and a resident nurse.

9.1.2 Community Problems

Providers and consumers interviewed for the ATS-6 project were also asked to name the major problems in their communities, including, but not restricted to, health. Providers were in agreement that alcoholism and mental health were the two biggest problems, with other major problems being lack of jobs and needed local improvements such as improved airstrips, municipal sanitation, and construction projects.

Many of the same community problems were named when consumers were polled. Alcoholism, poor housing, lack of understanding of native culture by outsiders, and poor mail service were cited. When providers were asked what they thought the people in the community perceived as the greatest need or problem, they gave similar responses. Alcoholism and mental health ranked first and second, followed by economic underdevelopment and lack of jobs, needed local improvements, lack of immediate medical care by a doctor, and the presence of whites in the community.

### 9.1.3 Communication Needs

Respondents were asked what sorts of communication or other programs would help alleviate the major needs they saw, and what improvements in communication services would be most valuable to them. In both cases, telephone service emerged as the overwhelming priority. The advantages of the telephone cited were that it would be a clear, reliable communication channel, that it could be used by the general public for personal business, that it would reduce the sense of isolation, and that it would allow for private communication, especially medical communication. In addition to telephones, desires were expressed for regular broadcast-type radio and television programming.

Other programs or improvements desired by the providers included more ATS-1 time for medical traffic, health education and alcohol abuse programs for the entire community, mental health counseling services, and the turning over of responsibility to the natives.

Consumer responses were quite similar to those of the providers. Answers included a need for reliable, instantaneous communication, health education programs for the entire community (not just the health aides), cultural orientation programs for outsiders, and more native participation in decision-making.

## 9.2 ATTITUDES TOWARD THE HEALTH CARE SYSTEM

Providers and consumers disagreed on the strong and weak points of the health care system, with the consumers being less positive in their assessment. Most providers and consumers thought the system was delivering quality health care, but most consumers said native people would go to private providers if their services were free. Consumers stated that they did not like to have projects implemented and then withdrawn after a year or two.

### 9.2.1 Strong and Weak Points of the Health Care System

Providers were asked to name the strong and weak points of the health care system as it is presently structured in Alaska.

The strong points mentioned by more than two providers were:

Care is provided in the remote villages (6)
The health care staff is dedicated and experienced (5)
Consulting and specialist back-up services are good (4)
Emergency help is available on a 24-hour basis (4)
Continuity of care is good (3)
Village facilities are being improved (3)

The weak points mentioned by more than two providers were:

Facilities in the bush are limited (5)
Lack of community and patient health education programs (3)
Poor follow-up in non-ATS-1 communities (3)

The consumers' assessments of the strong and weak points of the health care system were not so positive. When asked what was good about the health care now provided, three said it was always accessible, and two said it was free. Two said simply, "It's at least there." Others said it was thorough and gave a choice of whom to see.

As the weakest points about PHS health care, two consumers mentioned the negative attitude of the providers. Others mentioned the lack of enough MD's available after hours and on weekends for emergencies, insufficient number of specialists available, lack of adequate training for health aides, and lack of educational material on alcoholism, poor alcoholism treatment services, and poor mental health, child care, and dental care.

Both post-experiment consumer respondents noted poor communication between providers and patients as a major weakness of the health care system. One stated that providers fail to inform patients sufficiently about their health problems.

Four consumers rated the attitudes of professi -l health care staff in their communities toward native people as good to excellent, and one each rated it fair and poor. Comments included:

"Prejudice against natives."

"Some staff are unsympathetic and patronizing."

"Doctors and nurses get along well with native people."

"Staff must understand the culture and mannerisms of the patients; this takes time."

"Staff make no house calls."

Respondents remarked that the PHS was understaffed, provided poor service, and used doctors who were too young and inexperienced. One added that the PHS had a "bad reputation."

9.2.2 Quality of Care

Providers and consumers were asked to rate the quality of the health care now being delivered, and to say whether patients would prefer Indian Health Service care or private care if it were also available without cost.

The providers felt that the system was delivering quality health care. Four rated the quality of the health care as "excellent"; eight rated it as "good," and only one rated it as low as "fair." They also felt that the patients were satisfied with the services, and that most patients would choose the Indian Health Service (IHS) services over free care by private physicians.

Twelve of the 13 providers interviewed reported that patients were "satisfied" with the health care; one felt they were "very satisfied." Seven said that, given the choice, patients would choose IHS care over private care; only one said that patients would prefer private care. Two didn't know, and three said that the patient's choice would depend on factors such as the specific problem, the individual provider, and which source of care was closer.

Among consumers, four of the six rated the health care given to the people in the community as good or excellent, with two rating it fair to poor. Respondents estimated that 85% to 100% of the people in their community went to the PHS for health care. Five of the six felt that most people were satisfied or very satisfied with the care they got most of the time.

However, five of the six thought that most people would go to private providers if their service were rendered free of charge,

with some qualifying this answer by saying that it would depend on whether private or public providers offered better service and/or were more accessible.

Several interviewees noted that the increase in availability of programs like Medicaid and union health insurance plans was increasing the use of private doctors, but that the strength of the trend was difficult to estimate.

Finally, some consumers stated emphatically that they disliked having programs, whether explictly experimental or not, instituted and subsequently withdrawn. They implied that they would almost rather not have an improvement than have it discontinued after a year or two.

## 9.3 EFFECTS OF VIDEO AND AUDIO CONSULTATIONS ON THE HEALTH CARE SYSTEM

Most providers said that ATS-6 had made little difference to the quality of health care, but felt that time constraints had limited its potential. There were mixed opinions about the effects on travel. Specialists recommended a hierarchical system in which local providers would first consult GMO's who would in turn consult specialists when necessary. All were very positive about the role of ATS-1 Doctor Call in improving village health care.

The response of health care providers was weakly positive about the difference that ATS-6 video consultations had made in the ability of the health care system to deliver quality care. Two said that the video system made no difference in the quality of care, six said it made a little difference, one was undecided between a little and a lot, and one said that having video consultations made a lot of difference. None said that the video system lowered the quality of care. Two of the providers who responded "a little better" qualified their answers. One said it was a little better because of the X-ray capability it gave; the other said it was a little better but wasn't worth the cost.



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Many providers seemed to feel that, even if the potential usefulness of video consultation was not extremely high, the potential had not been fulfilled in this experiment because of situational constraints. A number of providers made the point that video consultations would be very handy if they were available on demand when needed, as in cases of severe trauma and cases for which immediate X-ray or EKG consultation were needed. The fixed schedule of the satellite prevented this, and also required that the available hour be filled. These constraints further diluted the local providers' perceptions of the usefulness of video consultations because they felt the cases presented were often fairly routine, or could have been handled by a more convenient telephone consult.

Opinions about the effect on patient travel were mixed. Responses ranged from "travel was increased considerably" to "much patient travel was avoided." Probably both statements are true. Patients who could be followed up on television or whose case could be taken care of locally were probably spared some travel. On the other hand, the facilities at the remote clinics are quite limited and many complex cases would have to be transferred to better facilities even if there were a doctor stationed at the remote clinic. So if consultants advised further tests on cases local providers thought were fairly routine, the patient had to fly to the hospital and travel was increased.

A few providers indicated that the consultations with community health aides were somewhat less efficient, because the medical training and verbal skills of the aides were lower, but that as a result there was probably more value to the video in these consultations.

A slightly different perspective on changes in health care practice resulting from the video consultations was found in interviews with specialists at the Anchorage Native Medical Center who were consultants on video cases. Their opinions were quite varied, often contradictory, because each was speaking about the cases in his or her own specialty. For example, a consultant in general



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surgery noted that video added to his diagnostic ability, but contributed little to changes in management plans. Conversely, a specialist in internal medicine reported that video consultations' contributions to change in management plans were much bigger than to a change in diagnosis. Some consultants found the picture to be a valuable source of perspective against which to evaluate the verbal descriptions of the remote providers because they feared that a local provider's use of unfamiliar technical vocabulary might inadvertently over- or understate the seriousness of the case.

The specialist consultants felt that "filtering" of cases before a specialist was called in would improve the efficiency of the system. They suggested a hierarchical system in which remote, non-physician providers would consult at the first stage with general medical officers (GMO's) in field hospitals. The specialists felt that the GMO's were usually capable of determining the potential seriousness of a case, but that the lower level providers were not well equipped to make such decisions. At the second stage, potentially serious cases would be transferred to the field hospital, where better facilities were available, and productive consultations could be carried out between the GMO's and the specialists.

Provider attitudes about the role of the ATS-1 Doctor Call network were very strongly and uniformly positive. Providers were asked to name differences that the possibility of having regular radio consultations had made to their ability to provide health care. They responded with the following items:

Radio consultations are a critical part of the ability to provide health care (3)
Emergency help is available (3)
The system is reliable; thus less conservative management plans can be followed (3)
Consults can be obtained for less than serious cases (perhaps unnecessarily) (2)
The skills and attitudes of the health aides have improved (1)
Unnecessary travel has been reduced (1)

Most of the providers pointed out that the ATS-1 Doctor Call system had made it possible to provide a reasonable level of health care in many isolated communities. The improvements made possible by the video consultation service were small by comparison. Some participants in the demonstration were pleasantly surprised when the video service surpassed their admittedly skeptical expectations; others were disappointed that the system's utility was relatively limited, and required large investments of time, energy, and resources. But there was a strong consensus that the ATS-1 Doctor Call consultations and the community health aides were the backbone of rural health care in the Tanana Service Unit.

### 9.4 EFFECTS OF THE VIDEO AND AUDIO CONSULTATIONS ON THE MAJOR HEALTH AND COMMUNITY PROBLEMS

Providers and consumers generally agreed that ATS-6 and ATS-1 systems had not helped to alleviate the major health and community problems, which most had cited as alcoholism and mental health.

Near the end of the questionnaire, providers were asked to refer back to their earlier answers about major health problems to evaluate whether the ATS-1 and ATS-6 services had helped solve the problems they had named.

Because they were asked to expand on previous answers and because the locale to which each referred was very different (ranging from a small bush clinic in a health aide's home to a large referral hospital), their answers were sometimes quite divergent. It will be remembered that providers had named alcoholism or other "social" problems that the satellite system would normally not be expected to alleviate (see Section 9.1).

Eight providers said that ATS-1 did not help alleviate major health problems they had named; four said that it did. Five said that ATS-6 had not helped with that same problem; four said that it did.

The trend was even more striking in the case of the major health problem perceived by the community, according to the provider.

Again, alcoholism and mental health were most frequently cited. Eight providers reported that ATS-1 had not helped with the problem they had named; one said that it had. Eight said that ATS-6 had not helped alleviate the problem; none said that it had.

The providers' estimation of the role of ATS-1 and ATS-6 in correcting some of the weak points in the health care system was slightly higher, but still predominantly negative. ATS-1 had not helped, according to seven providers, while five said that it had. ATS-6 had not helped correct the weak points in the system, according to five of the providers; three said that it had helped.

The consumers who were interviewed had similar reactions. Four thought that the ATS-1 project had not helped with the major health problems they had cited. Two felt that the ATS-6 project might help if it were used to disseminate video health education programs. Two thought the ATS-6 project would not help and two were undecided.

Two respondents thought ATS-6 had helped with the problem of provider-patient communication. One mentioned the possibility of the patient learning by listening to the teleconsultation. The other cited the importance in both ATS-1 and ATS-6 consultations of the health aide, who was able to communicate with patients.

Alcoholism, poor housing, lack of understanding of native culture by outsiders, and poor mail service were cited as the single greatest needs or problems in the community. When asked about the relationship between the satellite programs and the community problems, four respondents felt that the ATS-1 project had not helped with these problems, and three felt that the ATS-6 project would not help either. One thought the ATS projects could be helpful in that they showed that the PHS was starting to respond. One respondent said that the ATS-6 did address the need for providing reliable communication for health care, and thought it might save travel funds for the patient and the PHS.

These responses should not necessarily be construed as criticism of the role of satellite consultation services by the providers

or the consumers. Most respondents had said earlier that the major health problem was alcoholism, and that no one knew quite what to do to alleviate the problem. Neither the video nor the audio consultations was expected to solve community alcoholism or mental health problems. Rather, they were expected to provide reliable communication to support health care. In the case of ATS-1, the interviewees felt that the reliable communication had significantly improved health care in the bush, even if the improvements were not in the areas of mental health or alcoholism.

## 9.5 ATTITUDES OF PROVIDERS TOWARD TELECONSULTATIONS

The features providers liked best about ATS-1 were its dependability and good sound quality. They liked the ability of the doctor to see the patient and the X-ray and EKG transmit capability of ATS-6. Most disliked features of ATS-6 had to do with technical or organizational problems. Motion video was seen as being important but not always necessary; good color video was considered to have some value. Video transmission to remote sites was thought to be useful for education.

### 9.5.1 Liked and Disliked Features

The most liked and disliked features of ATS-1 and ATS-6 systems were investigated. The lists of features liked and disliked for the ATS-1 and ATS-6 had little in common, probably reflecting the fact that the systems addressed different sets of tasks. The features of the ATS-1 system that were singled out as especially good were:

Dependability (6)
Good sound quality compared to HF radio (4)
Daily availability (3)
Convenient, direct link to doctors (3)
Emergency call capability (2)
Users can learn by listening to Doctor Call (2)

The range of disliked features was wider, but fewer in total:

One hour was not enough time for Doctor Call (2)
Longer than one hour for Doctor Call takes too much of an individual doctor's time and is too exhausting (2)
Lack of confidentiality (1)
Health aides lack training in patient presentation (1)
Users lack training in maintenance of the equipment (1)
The system is available "on demand" only for emergencies (1)
Resolving authorizations for payment of travel is difficult (1)
System cannot be used for personal or other non-medical communication (1)

The features of ATS-6 that the providers liked included:

Doctor could see the patient (4)
Transmission of X-rays and EKGs (3)
Doctor's assessment was available without travel (1)
Patient can see the doctor (1)

The features of the ATS-6 teleconsultation system that the providers disliked were:

Fixed schedule problems, e.g., being cut off before finishing a consult, and not being able to use the service "on demand" (4)
Feeling of obligation to fill the scheduled time, even if there was no felt need (4)
Running the experiment was very time consuming and interfered with normal practices (4)
Technical problems with the equipment (2)
Equipment cumbersome to operate during consultation (2)
Equipment took up too much of limited clinic space (2)
A case taped for a consultant might not be acted upon quickly enough (1)

The providers were also asked what <u>problems</u> they had encountered in using the video teleconsultation system. They reported the following:

Technical problems with the equipment (5)
Problems handling the equipment and the presenting the patient at the same time (4)
Running out of scheduled time during a consultation (2)
Coordination and planning of use is difficult and time consuming (2)
Difficult to get the patient to talk (1)

Uncomfortable feeling among field providers of being "evaluated" by the specialists (1)
Consult capability was sometimes used because it was there, not because it was needed (1)
System not too useful because most complex cases have to be transferred anyway (1)

Most of the problems and disliked features cited by the providers for video consultations had to do with either technical or organizational aspects of the situation; they did not seem to have much negative to say about the idea itself. On the other hand, they offered about twice as many "dislikes" as "likes" when asked about video consultations, while the ATS-1 consultations drew about twice as many "likes."

9.5.2 Motion Video

Several topics of particular interest were introduced into interviews when time permitted. The most important concerned the providers' and consultants' opinions on the role played by color and motion, and the importance of two-way versus one-way video. The interviewees were unanimous in saying that they would prefer motion to still video pictures, but that in many consultations it was not absolutely necessary. The estimates of the percentages of the cases in which lack of motion would be an overwhelming obstacle ranged from about 10% of the internal medicine cases to about 50% of the orthopedic patient exams including more than an X-ray. The general consensus was that video consultations without motion would "lose a great deal" of subtle information, but would still be able to achieve the same result in the majority of cases.

9.5.3 Color versus Black and White

The demonstration was conducted over black and white television. Providers and consultants were asked what the value to them would be if consultations were conducted over color video instead. Three responded that, if the color balance and resolution were very good, then color might be useful for examining dermatological cases. If the color were not very good, however, it might be more confusing than helpful. Seven other providers who

answered the question all agreed that color was not necessary, although it might have a slight value in, for example, increasing interest in patient education sessions.

### 9.5.4 One-way versus Two-way Video

In this demonstration, the sites at Fort Yukon, Galena, and Tanana had switched simplex video. That is, they could transmit video or receive video, but not both at the same time. Anchorage could only receive video. For a remote health care provider to receive a video picture from, for example, the doctor at Tanana, the remote transmitter had to be turned off at the remote site and the Tanana transmitter turned on. The inconvenience of this procedure was probably one cause of the low frequency of use of the video system to "send" instructions from the hospital to the remote sites.

Several providers commented on the value of two-way video capability. A public health nutritionist felt that the ability to send pictures would be useful in patient instruction. A psychologist thought that it was important for the patient to be able to see the other person during counseling sessions. The remainder felt that the ability to send television to the remote sites would not be very useful for medical consultations, although the send capability might be valuable for medical education or other types of instruction.

One comment from an orthopedic surgeon summarizes the general attitude. He said that two-way video might be useful to show the remote provider how to conduct some exams, but that it would be better and probably cheaper to train the local provider before he or she had a patient to present.

## 9.6 ATTITUDES OF CONSUMERS TOWARD TELECONSULTATIONS

Most patients did not seem to mind being seen over the satellite. Consumer response to the ATS-1 program was highly positive; response to ATS-6 was rather ambivalent.



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In the planning stages of the demonstration, a great deal of discussion centered around the issue of maintaining confidentiality both of the video consultations and the medical records. It was feared that patient apprehension about lack of privacy, even if that apprehension were unjustified, would cause the patients to reject the system. The project staff worked very hard with the Satellite Review Committee to establish satisfactory guarantees of confidentiality and to spread accurate information about what the system was supposed to do and how it would work.

Perhaps because of these efforts, there were practically no problems with patient acceptance during the demonstration. In only one known case did a patient decline a provider's request to present him on television. In at least one other case, a patient asked that no one other than medical personnel be present during the consult.

When providers were asked about their patients' reactions to being seen on satellite television, they reported a very positive response. Three providers reported that their patients "accepted" being seen by a doctor via television, while six reported that patients "like [it] a lot." No negative reactions were reported.

However, some anecdotes do not paint so rosy a picture. One observer said:

> One aspect of the broadcast that needs to be mentioned is that better education for the patients has to be done. In many broadcasts the patient didn't know what was going on. Sometimes he knew who was talking, sometimes he even knew where. In many cases the patient didn't know why he was being broadcast and didn't understand how he could be helped by having his condition seen over the TV.

And this was in spite of diligent efforts by the local staff to explain the system.

This same observer commented that the problem was greatly reduced when patients were being seen for an acute problem, rather than when patients were "rounded up" because the local provider

needed someone to present that day. In the former cases, patients seemed to adapt well to being on television. Most were "microphone shy," but a few were able to participate actively in their own consultations.

Providers were also asked whether they thought that patients minded having their names used over ATS-1, which has less privacy than the video system. The majority said it depended on the patient's particular complaint. The examples given of cases in which patients might object to having their names used were venereal disease, gynecological cases, and alcoholism problems. The estimates of the percentage of patients who "mind" ranged from 5% to 50%.

Among features which the consumers particularly liked about ATS-1 were the primary function of communication between the health aide and a doctor, and immediacy and reliability. They did not like the lack of confidentiality, and one person suggested that patient identification numbers should be used instead of names. Three felt that people did mind having their names used on the system, one felt they did not, and two did not know.

Four respondents felt that patients would like being seen by a doctor over the two-way link and the other two thought they would not mind. Post-experiment respondents remarked that patients were "surprised," and that there was difficulty in convincing some that their picture could not be seen by everyone with a TV set.

The general consumer response to the ATS-1 satellite program was strongly positive. The general response to the ATS-6 program was better characterized as "not negative," and perhaps a little ambivalent. The difference in the attitude toward the two programs can perhaps best be illustrated by a pair of comments from the interviews conducted with consumers after the demonstration was over.

> "The satellite TV for medicine will only be missed in the few cases where it could have been useful."

"If ATS-1 is removed, that would set back the medical care delivery system here ten years."

## 9.7 OTHER DESIRED USES FOR VIDEO AND AUDIO CAPABILITY

Providers thought ATS-1 could be used for peer contact, teaching, and administration. Providers and consumers had several suggestions for the use of television in health education. Providers and consumers were pessimistic about the effect of broadcast television on alcoholism and mental health.

Providers were asked what other uses they would like to make of ATS-1 or a similar operational system. They responded that in addition to Doctor Call and emergency calls, there were other uses they would like to expand upon if time were available. Contact with peers received the most mentions, although one doctor remarked that he would prefer the privacy of a phone call for contacting others doing similar jobs. Teaching, especially during Doctor Call, got the second highest number of mentions. Use of ATS-1 for non-patient-related administrative communication was mentioned third. Time was so tight for completing Doctor Call that providers were asked to use other means of communication to transact administrative business. This limitation highlighted for them the important role of administrative communication. Other uses of interest were TB follow-up and personal communication. Eleven providers (out of 13) mentioned that they would like to see television used for health education, both for continuing education of providers, for patient education, and for community health education. One provider said he would like to see more clinics conducted over television. One provider felt that television was a time-consuming luxury item, and he did not want to see its use in health care continued.

When asked the same question, the consumers had a wide variety of suggestions for additional ways to use video in health care. Four respondents thought that satellite television should also be used for education programs in preventive medicine, and two suggested classes for health aides. Other suggestions included

programs in the high school on VD, birth control, and childbirth to help with the problems of unwed mothers. Programs on alcoholism, treatment of frostbite and burns, and personal hygiene were suggested.

Providers also mentioned uses of television for other areas besides health. Interestingly enough, educational television received many more votes than did entertainment television (eight to three). Other desired uses were for news and personal communication.

Television is sometimes promoted as an agent of social change for bush Alaska. Interviewees were asked what effects the introduction of entertainment television might have on the general level of understanding of health, reduction of alcohol problems, and the improvement of mental health. In the case of general understanding of health, the category with the largest group of responses (five) was "some change," usually described as incidental learning that might occur during exposure to entertainment television. Twice as many providers thought that there would be "no change" as thought there would be "much change" (four versus two). Three providers hoped that broadcast television might bring about "some change" toward the reduction of alcoholism, but seven felt that there would be "no change." Five providers estimated that there would be no change in mental health, three thought there would be some change, one thought that the situation might become much better, and one thought that it would become worse as a result of the introduction of broadcast television.

The positive expectations of providers included the hopes that TV would provide more diverse role models, greater stimulation, and larger vocabularies. The general level of expectation for television was not particularly high -- a typical positive comment was, "They might learn something [from television] and it would be something to do besides drink." Negative comments included fears that there would be undesirable side effects from the programming (for instance, that it would add to the problem of children's

apathy) and recognition that entertainment television would not change any of the things that caused problems in the social environment.

The responses of the consumers were roughly parallel, perhaps a little more negative. Three thought television would create some change in people's understanding of health, two thought there would be no change, and one felt that there would be much change. All of the respondents thought there would be no change in the rate of alcoholism.

In the case of mental health, two thought there might be some change, one thought there would be no change, and one felt the introduction of broadcast television would make the community's mental health situation worse. One respondent, from a site that already has some television, said that he thought that television "was destroying the mental health of the kids."

## 9.8 ATTITUDES TOWARD THE HEALTH INFORMATION SYSTEM

The Health Information System was regarded as a very valuable health care tool by those who had worked with it. Liked features outnumbered disliked features, and providers' high pre-experiment expectations for the system were confirmed.

About half of the providers in this demonstration had never used a problem-oriented record keeping system before the introduction of HIS. The range of experience in using such systems was nine months to seven years, with the average length of time being 2.7 years. Providers were asked to rate the relative usefulness of HIS records compared to the type of records they kept before; every provider rated HIS as more useful.

Providers were also asked whether the HIS system had helped them provide better care to their patients. Five providers each answered that the care was "a lot" and "a little" better as a result of HIS. One provider was unable to decide between "a lot" and "a little" and one felt that HIS had made no difference.



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Another question concerned the way in which HIS had affected work patterns for different topics. Table 9-1 presents the results. In the majority of cases, more providers rated the situation as having improved than as having stayed the same. No provider ever rated the Health Information System as having made the situation worse on any of the topics. The providers' comments about the HIS system confirmed the impression given by these data that they valued HIS very highly.

As a part of the post-demonstration interview, providers named liked and disliked features about the HIS system. Another indication that they were pleased with the HIS system was the fact that they were able, collectively, to name 34 things they liked but only 21 things they disliked.

The features that they liked about the system fell into four main categories:

- -- The quality of the record (14 responses)
- -- The ease of use by the records (12 responses)
- -- Operational advantages provided by the system (5 responses)
- -- The fact that it helped them improve their own record keeping (3 responses)

Examples of the kinds of remarks in each category follow.

Quality of the Record
The record provides data from other locations.
The record is organized around medical problems.
The problem lists and summaries are very comprehensive.

Ease of Use of the Record
The form is well organized.
Tests are easy to order and record results from.
The form is convenient to use.
The form is the same for all providers.

Operational Advantages Provided by the System
Referrals are easy to make.
Setting up clinics is aided by the ability to get output on patients with particular conditions.
Follow-ups are more systematic.
Multiple copies are handy to have.

TABLE 9-1

Effect of Health Information System Record Keeping on Health Care Provider Work Patterns and Capabilities, Calculated from Responses in the Post-demonstration Provider Interview

| Interview Questions | Effect of HIS on Situation | | |
|---|---|---|---|
| | Improved | Stayed Same | Became Worse |
| A. Time spent keeping records (N = 13) | 46% | 54% | 0% |
| B. Knowledge of health information about the patient (N = 13) | 85% | 15% | 0% |
| C. Keeping up with chronic conditions (N = 13) | 92% | 8% | 0% |
| D. Scheduling of return visits (N = 14) | 57% | 43% | 0% |
| E. Dispensing of prescription drugs (N = 8) | 50% | 50% | 0% |
| F. Patient's knowledge of his own health conditions (N = 10) | 40% | 60% | 0% |
| G. Confidence in doing own job (N = 11) | 45% | 55% | 0% |
| H. Getting patients' records from other places (N = 13) | 85% | 15% | 0% |
| I. Primary provider knowledge of medicines being used (N = 11) | 91% | 9% | 0% |

Improvement of Own Record Keeping

The form forces one to make a diagnosis.
The system helps keep records up-to-date.
The organization of the form systematizes one's own record keeping.

One provider stated that even if the computer system were dropped, he would have his own HIS-format forms printed because they consolidated so much information.

The negative comments were also sorted into several major categories. Those categories were:

-- Start-up problems (8 responses)

-- Operational problems (7 responses)

-- Structural complaints (6 responses)

Examples of these types of negative responses include:

Start-up Problems

Not enough instruction was given in the use of a few sections of the form.
Getting used to the forms was difficult.
Putting in retrospective data led to problems of incomplete data and errors in the data file.

Operational Problems

There is not enough room to write on the form.
The carbon copies are often illegible.
The system wastes paper and leads to very bulky patient charts.
You have to fill in the whole form every time.

Structural Complaints

The records are not updated quickly enough.
There is a lack of compliance by some users that limits the utility of the whole system.
The future scheduled encounters section is a waste of time.

The consumers also had high regard for HIS. In the pre-demonstration interviews, all thought that the HIS record keeping system would help provide "a lot better" care. They mentioned the availability of complete medical summaries to the doctors, the possibility of keeping consistent accurate records, and the quick

reliable retrievability of records as advantages of HIS. In the post-demonstration interviews, consumers still felt that the HIS system had helped provide "a lot better" care.

## 9.9 SUMMARY

Users of the demonstration system generally had mixed reactions to the video teleconsultation service, and very strong positive reactions to the Health Information System for medical records. The main problems in the bush are said to be alcoholism and mental health. Neither the ATS-1 nor ATS-6 system was seen as doing much to alleviate these problems. Respondents reported that the biggest contribution that could be made by a change in the communications media available in the bush would be the installation of reliable, publicly accessible telephones.

Both providers and consumers were aware of shortcomings in the health care delivery system as it now exists, but appreciated that the fact that it existed at all was a point in its favor. Most complaints about the health care system were related either to problems caused or exacerbated by the physical circumstances of Alaska, or to communication difficulties between the mostly white medical personnel and the natives. Almost all of the respondents felt that the quality of care was at least good.

The health care providers report that the implementation of the ATS-1 Doctor Call network was a vital step in improving bush health care. The improvements made possible by the ATS-6 video consultation system were small by comparison, and consequently the inconveniences accompanying the operation of the video system were less willingly borne. Because of the structure of the demonstration situation, there were many such inconveniences.

Providers and consultants reported that color television would have added little to the consultations. They felt that motion, as opposed to still video, was an absolute necessity in 10% or more of the cases. They saw little significant medical value, but considerable educational value, in being able to transmit to the remote sites.

There were virtually no serious problems with acceptance of the video teleconsultations by the patients. Only a small proportion of the patients seemed completely at ease being on camera, but the discomfort of the others did not impede the consultations and was not high enough for the patients to refuse to participate.

Interviewees were interested in seeing television put to other uses in addition to teleconsultation. They suggested health education programs, both for health care personnel and for the public, as a potentially valuable use of the video. Others were interested in video for entertainment, as well, but there were some reservations about the advisability of introducing commercial broadcast television.

The contributions of the Health Information System were highly valued by all participants. They found it convenient to use, capable of providing quality records, and very successful at overcoming the problems caused by institutional and geographic separation of health care delivery units.



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## CHAPTER TEN

## IMPLICATIONS FOR OPERATIONAL SERVICE AND FUTURE RESEARCH

The primary purpose of projects such as the ATS-6 Alaska Biomedical Demonstration is to obtain information that is useful for improved planning of operational services. Information about successes and about problems are equally valuable for planning purposes. Some of the information may be useful immediately. Other information may indicate which directions for future research are most likely to lead to benefits later.

A major task of an outside evaluation group is to put the evidence gathered during the project into a larger social context to help determine which features should be carried into operational service, which require further experimentation, and which should be dropped. The major pay-off from a project like this is in the improvement in the quality of planning for future services that becomes possible as a result of the demonstration. Therefore, a major part of the evaluation task has been to examine the options available for operational service and future experiments in the light of the evidence from this project. The evaluation task has been to identify the potential benefits and costs so that the appropriate information is available to policy planners.

Planning for operational biomedical communication services is more difficult than planning for demonstration projects because scale factors are different and because a larger social context must be taken into account. The demonstration may take place in a small number of communities, but economic viability of an operational system may require that a much larger region be served. The number of institutions involved in a demonstration project may be kept small, but operational service may require involvement by communication common carriers and local, state, and federal government agencies beyond those involved in the smaller project. The

problems associated with inducing a monopoly common carrier to offer communication services are more complex than those involved in mounting a demonstration controlled by the federal government. There are many other needs besides health care that lead to the requirement for reliable communication within Alaska. Because of the major economies to be obtained from sharing communication facilities across a larger number of uses and users, effective planning in this situation requires that other communication needs and institutional constraints be taken into account.

The following sections describe the alternatives that seem appropriate to examine in the light of the results of the ATS-6 Alaskan telemedicine project. They also present some cost projections that policy planners will need to study before choosing among these alternatives.

## 10.1 OPERATIONAL VOICE COMMUNICATION: THE FIRST PRIORITY

The ATS-6 project provided further evidence in support of the conclusion that was already evident as a result of the earlier ATS-1 project. The first and highest priority is to provide reliable, operational, 24-hour a day voice communication linking together health providers throughout Alaska, especially in remote communities that are now without any reliable communication facilities. The utilization of ATS-1 in Galena and Fort Yukon during the ATS-6 project demonstrated that even communities with a telephone right in the village medical clinic could benefit from and effectively utilize the multi-party conference capability and the higher reliability of satellite voice circuits.

The continued dependence of the Tanana Service Unit of the Alaska Area Native Health Service on the ATS-1 satellite for medical communication presents an urgent requirement. It would be medically and politically unacceptable to turn off the service on which the people have come to depend for medical care. But ATS-1 is an experimental satellite long past its life expectancy, without a back-up in the event of failure, and without authorization or

mandate to provide operational services. Health care providers, patients, native organizations, and state and federal government agencies now appear to be in complete agreement that the highest priority for biomedical communications in Alaska is to provide operational voice communication service to all Alaska communities. The Lister Hill National Center for Biomedical Communication which sponsored the ATS-1 biomedical satellite project in Alaska and its evaluation was a major force in bringing about this policy consensus and the resulting plan for implementation of operational services.

> Recommendation 1: The Indian Health Service should continue to assign top priority to implementing reliable operational voice communication reaching all communities in Alaska.

### 10.1.1 Rate Determination

The technical design of the 100 small earth stations purchased by the State of Alaska in 1975 has taken into account the requirements of the Alaska Area Native Health Service. Five satellite voice channels will be dedicated to the health service for its exclusive use 24-hours a day. Each of the 100 earth stations will be able to access all five channels, although most stations will be able to access only one of them at a time. Use of these channels is not interfered with by regular telephone traffic which may take place concurrently from the same communities. The first 20 stations are expected to come into service in March 1976. An additional 40 locations are expected to become operational later in 1976, with the remaining 40 locations becoming operational during the 1977 construction season in Alaksa. Final details of design and procurement of the terminal instruments and details of procedures for operational use are now being worked out by the Indian Health Service. One technical issue still to be resolved is how to provide the alarm signal that allows a remote location to alert a hospital to the occurrence of a medical emergency for which consultation is urgently requested. This alarm feature was found to be very beneficial in the ATS-1 operation. Once the technical issues



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are resolved, the Indian Health Service will need to test and evaluate techniques for effective operational utilization for both health aide-to-doctor and doctor-to-doctor consultations.

The major issue still outstanding is tne cost to the Indian Health Service. The earth stations are owned by the State of Alaska, although they are being installed and operated by RCA Alascom. The State and RCA jointly hold the FCC licenses, pending the outcome of the dispute between them as to ultimate ownership arrangements. RCA has the interim operating authority. The costs to the Indian Health Service will depend on the tariffs proposed by RCA, subject to the approval of the Alaska Public Utilities Commission (APUC). None of the present RCA tariffs are applicable to the new medical communication services because these services are quite different from any service previously offered by RCA. The costs to RCA are dramatically lower than the costs of terrestrial facilities, partly because they are independent of the distances involved (satellite and ground station costs are not affected by whether the locations are 30, 300, or 3000 miles apart). The satellite circuits required are only half duplex circuits (half of the full duplex or simultaneous two-way voice channels supplied for standard leased line telephone circuits). In the remainder of the United States (but not in Alaska), RCA Globcom (the parent company of RCA Alascom) has filed tariffs for leased line satellite circuits on the same satellite RCA Alascom is likely to be using. Those tariffs are independent of distance and should be considered as relevant precedents.

RCA has suggested to the Indian Health Service that the current leased-line tariff of $3.50 per mile per month be applied to the Indian Health Service system. Most observers consider this excessive for technology that is relatively low in cost and distance insensitive. In order to avoid being subjected to such excessive charges, the Indian Health Service should conduct, or have conducted, a study of the RCA costs and revenue projections from the small ground stations. Such a study is likely to be needed in

order for the Indian Health Service to argue effectively the tariff issues involved before the APUC. Since the small earth stations will also be used for standard telephone service and for leased circuits to other customers, the installed costs of the earth stations and the satellite lease charges cannot be used directly to calculate an appropriate rate. Cost allocations must be performed to allocate to the Indian Health Service an appropriate share of the total costs. This will depend in part on revenue projections for other services. The Indian Health Service should insist that RCA revenue projections be made part of the public record at the APUC as part of the tariff proceedings. Once a tariff as been approved by the APUC, the Indian Health Service will need to obtain the necessary appropriation of federal funds before entering into lease agreements with RCA.

> Recommendation 1a: The Indian Health Service should take immediate action to ensure that the rates for services proposed by RCA or approved by the APUC are set on a distance-independent basis and are justified by appropriate cost and revenue analysis.

### 10.1.2 Continuing Education

Once the technical and cost issues have been resolved and the new voice channels have been integrated into the health care delivery system, the costs of providing continuing education for health aides on the channels already leased for health care delivery should be relatively small. It is possible that there could be cost savings in the health aide training program (or an increased level of training at comparable costs) through the substitution of communication for transportation. The success of the ATS-1 nursing course, in which nurses at remote locations did as well as those receiving face-to-face instruction, provides some basis for optimism in this respect.

> Recommendation 1b: The Indian Health Service should begin planning to utilize the soon-to-be-available voice channels in a program of continuing education for village health aides.

## 10.2 HEALTH INFORMATION SYSTEM

As part of the ATS-6 project, the Indian Health Service introduced a computerized problem-oriented medical record system called HIS (Health Information System) into the Tanana Service Unit. A formal evaluation of the impact of the changed record keeping system on the quality of health in the Tanana Service Unit was not requested of the evaluation group, nor was it possible because of all the other changes going on in the service unit at the same time. HIS was used effectively to gather and tabulate data necessary for evaluation of the satellite communication project. Evidence from a variety of sources also indicates that HIS was a valuable addition to the health care system.

The evidence comes from the positive attitudes of the health care providers, from the positive attitudes of the client population, and from the logical analysis of the improvements in the quality of health care that the health record system makes possible. Providers and patients agree that having an adequate health record summary available for each patient encounter is particularly valuable when the health care is provided at a variety of locations. For example, a patient living in Venetie might receive care from the Village Health Aide in consultation with the doctor at the Tanana Hospital. On a different occasion, the same patient might receive health care from the nurse at the Fort Yukon clinic. On other occasions care might be provided in Tanana, Fairbanks, or Anchorage. It is helpful to the health care provider in each location to have a full medical record of care delivered at the other locations, whether the care is for chronic or acute conditions.

In addition to improved chronic or acute care, the Health Information System makes possible health status monitoring and improved preventive medicine that would otherwise be difficult to provide. Through HIS, doctors on field trips to outlying villages can obtain a complete listing of patients in need of follow-up care, tests, or immunizations. The records can be statistically aggregated

to measure the health status of populations. The individual records of patients making up those aggregations can be used on the patient's next encounter with the health care system as a reminder, for example, of overdue pap smear tests for women of child-bearing age, children's immunizations, or medical check-ups and follow-ups.

A third basic advantage of HIS (or comparable medical record systems) is that better evaluation of medical services and improved medical research was made possible by the health record system. In the ATS-6 project, the health record system was changed when the satellite experiment was begun, making it difficult to determine whether a difference in the recorded quality of health or health care was the result of the satellite, or was merely an effect of the change in the recording system. Even with that one-time disadvantage, HIS was useful for the ATS-6 evaluation research because the evaluation judgments of the health care providers about each case were recorded on the same form used for the patient medical record without requiring the providers the fill out additional record forms or making it difficult to link the evaluation judgments to the medical records with which they were associated. For future experiments it will be possible to establish criteria for the health status of populations to be served or criteria for health care delivery (e.g., the percentage of people with up-to-date immunization or pap smear tests). The change in those criteria in the patient population over the period of the study could then provide better evidence of the impact of the experimental intervention. Improved ease of access to all records with a particular diagnosis could also be an advantage for some kinds of medical research.

It was understood by participants in the ATS-6 demonstration that the satellite would be available only for nine months and that the video part of the project could not be continued on an operational basis. But since the HIS can continue without the satellite, it would be unfortunate if that improvement in the health care system were discontinued by administrative decision or inadvertence. The Health Information System is one of the few

immediate improvements in the health care system that can be left as a legacy of the ATS-6 project.

> Recommendation 2: The HIS should be maintained on a permanent basis in the Tanana Service Unit and should be expanded as rapidly as possible to the rest of Alaska.

## 10.3 VIDEO AND TELEMETRY ON VOICE-BAND CHANNELS

Some of the successful features of the demonstration included transmission of X-rays and electrocardiogram (EKG) data via ATS-6. Such data can be transmitted through voice (narrow-band) channels as well as video (broad-band) channels. Still video pictures can also be transmitted through narrow-band channels. Since operational narrow-band channels for voice communication will be introduced into the Alaska health care system beginning in 1976 for communities previously without reliable voice communication, the logical next step is to determine the costs and benefits of adding slow-scan video, facsimile, data communication, EKG transmission, stethophone, or other medical telemetry to the voice channels that will be available. Some technical development may be required to connect the necessary special equipment to the kind of voice channel that will be available. Once technical problems have been resolved, field tests will be required to determine the usefulness of each device in a clinical environment. For those facilities and features that are proven useful, decisions can be made concerning whether the benefits justify the costs of widespread installation.

> Recommendation 3: The Indian Health Service should begin field tests of slow-scan video, medical telemetry, facsimile, and data transmission techniques using voice grade (narrow-band) channels.

### 10.3.1 Slow-scan Video

The price of slow-scan video receiver components is estimated at $6,350, based on a $6,000 price for Video Expander Model 261

of Colorado Video, and $350 for a television monitor. The price of slow-scan video transmit components is estimated at $4,850, based on a $3,000 price for Transmit Encoder Model 260 of Colorado Video, $1,500 for a black and white television camera and accessories, and $350 for a transmit monitor (October 1975 prices). Discounts are available for quantity purchases. At these prices, relative to the very high prices for full-motion video to be discussed below, a program of experimentation and trial use of slow-scan video in the clinical environment seems more likely to lead to operational video services in Alaska in the near term. Given the high costs of color video equipment, including high maintenance costs, and lower reliability because of the more sensitive equipment, implementation of color capability does not appear reasonable at this time.

Since slow-scan video equipment is designed for transmission on a dedicated channel linking two points, special adaptation may be required for effective use on the multi-point channels that will be available to the Alaska Area Native Health Service. For some purposes, it may be desirable for two or more receiving stations to receive the same transmission, just as remote clinics, the Tanana Hospital, and the Alaska Native Medical Center in Anchorage were all able to receive ATS-6 transmissions. It may be necessary to install scrambling equipment or secure addressing procedures to prevent other locations from also receiving the signals, thereby endangering patient privacy. It may also be necessary to add protective devices to prevent potential interference from other locations with access to the same multi-point voice channel. In the event that these technical problems cannot be readily or cheaply solved, it may be necessary to conduct the slow-scan video field tests on standard two-party telephone circuits.

Once the basic equipment is installed and working satisfactorily, it should be subjected to a variety of uses, including transmission of X-rays, EKG tracings, and document transmission, as well as transmission of signals from the camera. To get an

idea of the potential advantages and difficulties with such equipment in different settings, it would be appropriate to conduct the field test in at least three locations, including a remote site staffed by a health aide, a regional field hospital, and the Alaska Native Medical Center in Anchorage.

> Recommendation 3a: The Indian Health Service should plan a field test of slow-scan black and white video equipment involving at least three locations in order to obtain more detailed information on the benefits and costs associated with a larger scale implementation.

### 10.3.2 Biomedical Telemetry

During the ATS-6 project, participants found the electrocardiogram (EKG) transmission capability to be a useful feature. For some unknown reason, possibly technical, the electronic stethophone devices did not operate satisfactorily. This result is consistent with the findings of other studies that a very high quality channel is required for effective use of the electronic stethophone (see Chapter 2). Further development and field trials seem to be called for in both cases in order to interface both kinds of telemetry to the satellite voice channels that will become available during 1976. Only after the stethophone is functioning properly on audio channels that will be available for continued operational service will it be possible to determine satisfactorily the clinical utility in field settings. If the EKG and stethophone equipment are judged technically adequate and functionally useful, plans should be drawn up for a phased implementation in those locations where experience indicates that they will be useful. The planning should include preparation of detailed instruction and training for health aides who will be using the equipment.

> Recommendation 3b: The Indian Health Service should prepare plans for field testing and implementation of biomedical telemetry, including development of health aide training programs in the use of such telemetry.

10.3.3 Facsimile Terminals

A variety of facsimile or telecopier devices are available or could be available for transmission of text and photographic material over audio channels at costs less than the slow-scan video capability needed for presentation of patients to a remote physician. Telecopiers may prove useful and economical for some patient record transmission and for performance of many administrative message functions. Facsimile or telecopier equipment might prove particularly useful during those periods when poor weather means that the mail planes are not flying and mails are delayed for days or weeks. It may prove useful also to develop an "all-station" telecopier technique such that messages going out from a hospital to all health aides need be transmitted only once on a channel to which all locations have access. Such a capability may also prove useful for continuing education of remote health care providers.

> Recommendation 3c: The Indian Health Service should conduct a comparative analysis of available facsimile and telecopier terminals in order to select equipment for field testing in Alaska and possible widespread implementation.

10.3.4 Data Transmission

Techniques suitable for shared data communication on voice band channels via satellite links are available in principle. That is, computer networking experts appear to be in agreement that a channel sharing technique called "packet contention," such as that used in the experimental Aloha Network in Hawaii, appears to be the appropriate technique for Alaska. Hardware to implement those techniques on the type of channels available to the Alaska Area Native Health Service does not yet exist. Professor Kenneth Kokjer of the Electrical Engineering Department, University of Alaska, is currently engaged in research and development leading toward the necessary equipment and procedures. Successful development and commercial availability of such equipment may permit a reduction in present Indian Health Service costs of teletype channels and permit

increased use of computerized information systems for both medical records and management information systems, including ordering of supplies. Development of terminal equipment and transmission techniques that could substitute for the present IHS teletype network in Alaska might save money as well as provide improved services.

> Recommendation 3d: The Indian Health Service should encourage and support the research and development necessary to perfect reliable and economical data communication techniques using shared narrow-band satellite channels accessible from the small ground stations being installed in Alaska.

## 10.4 BROAD-BAND VIDEO, PRESENT SATELLITES

The experimental ATS-6 satellite utilized 22 watts of power in the satellite video transponder, permitting video reception at earth stations 10 feet in diameter costing less than $5,000. Presently available commercial satellites, including Western Union's Westar, the Canadian Anik, and the proposed RCA and AT&T satellites, all have only 5 watts of power per transponder, requiring more expensive ground stations. The cost estimates for satellite channel leases range from a projected $750,000 per television channel per year for future satellites up to an actual $3,000,000 per television channel per year for Anik. For budget planning purposes, $1,000,000 per channel per year now appears to be a reasonable price estimate.

It will be possible technically to receive television at the 15-foot earth stations being installed throughout Alaska, although the technical quality of the picture is likely to be poorer and less reliable than network quality television. This lower quality results from the fact that the power radiated to Alaska from continent-wide 5-watt satellite transponder beams is right at the margin of what can be received with a 15-foot diameter antenna. When all equipment is working perfectly and atmospheric

conditions are good, an acceptable picture may be received throughout much of Alaska, but slight degradation of equipment functioning or unfavorable atmospheric conditions could lead to degraded quality. The quality of picture will decline the further west the earth station is located. Stations at the longitude of Juneau, Anchorage, and Fairbanks may receive acceptable pictures, but locations on the west coast of Alaska may receive poorer quality and locations on the Aleutian chain may not be able to receive television at all on 15-foot diameter antennae.

To receive good quality television in most locations, an estimated \$50,000 in additional television reception equipment would have to be installed at each earth station. The low noise preamplifiers necessary to receive television cost approximately \$50,000 per pair. A pair would be needed at each location for the redundancy necessary to provide reliable operation. (The alternative would be to attempt to have highly qualified technicians available at each location.) In addition to the amplifier, a video demodulator (\$2,000) and frequency downconverter (\$1,500) would be required at each location. Quantity purchases could bring down the price, but installation costs would have to be added, so that \$50,000 per location might be a reasonable estimate. These costs are in addition to the equipment already in place or planned for telephone services. If a lower quality of television is acceptable, then new "threshold extension demodulators" now being developed by at least two manufacturers may permit television reception by the 15-foot earth stations at a cost of about \$10,000 per station.

Transmission of television to the satellite is not possible from the 15-foot earth stations. A larger earth station (approximately 26-foot diameter or larger) or extremely expensive transmitters with power in excess of 7,000 watts would be required for television origination. Larger stations are available in Alaska for origination from Fairbanks, Anchorage, and Juneau, and are planned for a few other locations, including Bethel. The additional



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equipment required to transmit television from these "gateway" stations ranges from approximately $100,000 to $150,000 per location, depending on the quality of signal desired and cost of local installation.

Therefore, it is technically impossible to have two-way video transmission between most Alaska locations with satellites presently available or planned, except for a few locations (e.g., between Bethel and Anchorage), unless hundreds of thousands of dollars are invested at each location. If RCA Alascom were willing to bear all the capital costs and offer service on an hourly rental basis, then it might be reasonable to experiment with two-way video consultation between the Bethel Hospital and the Alaska Native Medical Center in Anchorage. But a larger scale operational service is not technically or economically feasible at this time.

The ATS-6 project demonstrated the usefulness of video consultation permitting medical specialists at Anchorage to see patients at the Tanana Hospital, as well as consultations in which patients at more remote sites were seen by physicians at Tanana or Anchorage. It is possible that more economies of substituting remote video consultation for travel may eventually be achieved through this kind of service than through consultation between hospitals and remote sites without physicians, because cases of at least moderate severity may require travel to the hospital for treatment by a physician in any event. The larger numbers of patients seen at the Bethel Hospital may permit a useful exploration of this possibility if a video link between Bethel and Anchorage were established on an experimental basis. Such an experimental link would be a better simulation of possible operational use if it were available on demand rather than at scheduled times. That way it could be used when medically needed, but without creating pressure to use it at scheduled times whether or not it is really needed for medical care. Therefore, if reasonable prices are offered by RCA for on-demand video linkage between Bethel and Anchorage, and if there are both personnel and financial resources available for such

experimentation in addition to implementing the higher priority Recommendations One, Two, and Three above, continued exploration of video teleconsultation possibilities should provide useful information for long-range planning of health care in Alaska.

> <u>Recommendation 4</u>: Because operational two-way motion video services throughout Alaska are currently neither technically nor economically feasible, such service should not be considered by the Indian Health Service at this time. Information useful for planning possible future services could be obtained from an experimental video linkage permitting medical specialists at Anchorage to view patients at Bethel.

### 10.4.1 One-way Video for Education

If television reception equipment were added to the small earth stations for other purposes (e.g., commercial or public television reception), then it would be worth considering the rental of satellite transmission time for health education purposes, either for training of village health aides or for health education for school children or the general public. At this time it does not appear reasonable to consider installing a one-way video transmission system throughout Alaska solely for health purposes. Nevertheless, it would be timely for the Indian Health Service to review its education and training requirements in the light of the potential future availability of video distribution throughout Alaska, so that these requirements can be taken into account in the statewide planning for video distribution services.

> <u>Recommendation 4a</u>: The Indian Health Service should prepare a statement of requirements for one-way video distribution (e.g., for health aide training or community public health information) to submit to the Alaska Governor's Office of Telecommunication so that current planning for statewide video distribution services takes into account future IHS requirements.



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## 10.5 BROAD-BAND VIDEO, FUTURE SATELLITES

The present generation of operational domestic satellites does not permit low-cost video distribution or low-cost two-way video transmission to and from small ground stations. With two major changes in the spacecraft -- increasing the transponder output power and the transfer gain (amplification) of the transponder -- video transmission from and distribution to small earth stations (10-foot to 15-foot diameters) would be economically feasible. Increasing the transmitter power means that a less sensitive ground station is needed to receive a video signal from the satellite. Increasing the transfer gain means that less uplink transmitter power is required for ground stations to transmit signals to the satellite.

There are technical limits to the extent of the reduction in uplink power requirements that can be obtained, and there are regulatory conflicts relating to potential interference. Therefore, remote origination of a television signal from a 15-foot antenna would still be quite expensive, but it would not be out of the question if benefits were judged to be worth the cost. A 1,000 watt television transmitter would be required at a cost of approximately $85,000 per 15-foot ground station.

With a higher power transponder, such as 20 watts of downlink power for each television signal from a satellite beam shaped to cover the U.S., including Alaska, the 15-foot stations now being installed are sensitive enough to receive video signals. The only additional cost would be for the frequency downconverter (to a frequency more suitable for continued processing) and the video demodulator. With a quantity purchase (e.g., one for each of the 100 small earth stations), the cost might be as low as $3,500 for each receiving station. For video origination from a master station (26-foot diameter or larger), the only additional equipment required would be a 200-watt amplifier and a currently available commercial low-noise preamplifier. Costs of origination equipment for a large station would be about $40,000.

The Public Service Satellite Consortium, which has received its initial funding from membership fees and from a grant from the federal government through the Department of Health, Education and Welfare, is developing plans for such a second-generation satellite that would permit economical video distribution throughout the United States, including Alaska, for educational, health, and other public service uses. Launch of a PSSC satellite could take place in 1978, the year after the last of the 100 small ground stations for Alaska service come into operation. Other governmental, private non-profit, or commercial organizations may also help achieve the goal of providing a high-powered satellite suitable for operational use in Alaska.

Given the high costs of video transmission and distribution on present satellites and the possibility of a satellite more appropriately designed for low-cost video services being available in two or three years, it would be a mistake for the Indian Health Service to enter into long-term agreements for operational video services on present satellites. More experimentation is required in the meantime to clarify how effectively the requirements can be met with narrow-band equipment and what additional broad-band requirements will remain unmet after the narrow-band services (including slow-scan video) are implemented.

> Recommendation 5: The Indian Health Service should work closely with other agencies and organizations sharing common interests and objectives in planning satellite communication systems for health service delivery, including the Public Service Satellite Consortium. This activity should include the preparation of technical plans and cost projections associated with different possible uses of video ranging from limited experimentation to full-scale statewide implementation of one-way video transmission (for education programs) and two-way video linking most Alaska locations for operational video telemedicine services.

## 10.6 SERVICES OUTSIDE ALASKA

The agencies involved in the Alaska satellite telemedicine project do not have the same moral imperative to plan operational

services for people in other locations, as they do for the people whose lives were influenced directly by the satellite demonstration project in Alaska. Nevertheless, much of what was learned in the Alaska project is applicable to health care delivery systems elsewhere in the United States and throughout the world. This project demonstrated that native health aides with limited formal education and even more limited medical training could effectively utilize sophisticated communications equipment to obtain medical consultation from physicians, including medical specialists, in the course of providing health care to their clients. That demonstration in both the ATS-1 and ATS-6 projects in Alaska, coupled with the highly favorable attitude among rural native peoples in Alaska to the health aide system, provides a model that can be applied in a wide variety of locations from core cities in the United States to rural areas of less developed countries. In U.S. cities a communication satellite will not be the appropriate technology for the communication link, as might well be the case for less developed countries. The choice of which technology to use to deliver reliable communication between two points depends primarily on which technology is most economical. The major conclusion for health care planning is that health care services can be delivered effectively by paraprofessionals who can use communication channels to receive consultation from physicians.

> Recommendation 6: Health care planners outside Alaska should seriously consider health care delivery systems in which the primary provider is both geographically and culturally close to the client population, using communication technology to obtain consultation from physicians. The favorable results in Alaska deserve to be copied elsewhere.

10.6.1 Planning for Satellite Use in Health Care

Within the United States, the first generation communication satellites presently available for operational use are not technically suitable for telemedicine services, even though the

ATS-6 experimental satellite demonstrated the technical feasibility of such services. For locations geographically distant from urban medical centers, appropriately designed satellites could provide more economical communication links than terrestrial communication technology. The organization most actively pursuing these possibilities in the United States at the present time is the Public Service Satellite Consortium.

> Recommendation 6a: Health care planners concerned with provisions of health services to areas of the U.S. that are geographically distant from urban medical centers should work with the Public Service Satellite Consortium or other appropriate organizations to explore system design and cost considerations for operational satellite telemedicine services using either audio or video communication links.

### 10.6.2 Planning for Developing Countries

The lessons of ATS-1 and ATS-6 for health care in Alaska may have greater applicability for less developed countries throughout the world than for the rest of the United States, where both health care delivery systems and communication systems are well developed relative to the rest of the world. In countries without extensive terrestrial communication facilities, it is dramatically cheaper to provide communication links to remote areas by satellite than by terrestrial means (Lusignan et al., 1975). In countries without an extensive physician population distributed throughout the country, a health care delivery system based on paraprofessionals with communication capability for consultation with physicians may be the only possible way of bringing quality health care to remote populations.

> Recommendation 6b: Health care planners concerned with provision of health services for developing countries should explore the possibilities of health care systems utilizing paraprofessionals with communication links to physicians for medical consultation.

<u>Recommendation 6c</u>: Health care planners for developing countries should explore the possibilities of communication satellites for providing more economical communication links between remote paraprofessionals and consulting physicians than can be obtained by other technical means.

## 10.7 TERMINAL DEVELOPMENT

For some time to come the channel capacity that will be available to a large number of locations for two-way communication is likely to be narrow-band audio channel capacity. In Alaska and in other locations it will be economical to share that capacity across a number of users or user locations rather than incur the expense of dedicated channels linking each pair of points, most of which will be unused at any given time. At each location there may be multiple uses for the audio channel capacity, including voice communication, medical telemetry, facsimile, data communication, and slow-scan video transmission.

Terminal equipment with the features desired for operational use with the conference circuit voice channels available in Alaska is not readily available. Multiple locations will be sharing a simplex conference circuit. The ATS-1 experience proved that it was essential to have a selective alarm signaling device for this kind of circuit in order for a remote location to alert the field hospital to the existence of a medical emergency. Appropriate interface devices (in some cases a simple jack would suffice) are necessary to connect medical telemetry, facsimile, slow-scan video, or data communications devices to the circuit. Devices and procedures are required to protect the privacy of medical transmissions and to prevent other locations with access to the circuit from causing interference. It is important that the resulting terminals be simple and easy to use and that the terminals be highly reliable because of the remote and rugged environment in which they will be located. Faults should be easy to diagnose and repair. Reduction of cost is an important consideration in the development of the

terminals, but it should be remembered that it is total cost, including operation and maintenance, that should be reduced, not just the capital cost of the equipment.

> Recommendation 7: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development activities leading to improved-capability and reduced-cost terminals for multi-function and time-shared use of audio channels.

### 10.7.1 Slow-scan Motion Video

One of the major advantages of the ATS-6 medical transmissions that cannot be met by presently available slow-scan video equipment is the transmission of motion video, permitting a physician to see the range of motion of which an ill or injured patient is capable. In most cases it was not essential that the transmission be instantaneous "live" transmission. In many cases, the motion video was recorded on video cassette at the Alaska Native Medical Center for a specialist to view at a later time, with telephone consultation between provider and consultant concerning the appropriate treatment taking place after the consultant had viewed the videotape.

One possible economical way of providing this kind of motion video capability on existing audio channels would be to develop slow-scan motion video terminals that will permit a short black and white video sequence recorded on a three-quarter inch video cassette (or other appropriate medium) at the remote site to be transmitted to a similar cassette at the hospital location where consulting services are available. The techniques for this kind of service are generally known, having been used by NASA for transmission to earth from space.

If sufficiently low-cost terminals suitable for use in the Alaska environment can be developed, they may have useful applications in other locations also. The fact that a simple audio channel uses only about one thousandth of a satellite video channel should make such a system economically attractive.

Recommendation 7a: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development leading toward low-cost slow-scan motion video terminals.

## 10.8 CHANNEL-SHARING RESEARCH

Communication channels, especially video bandwidth channels, are likely to remain expensive for a long time. Satellite lease costs for video channels may continue to cost as much as one million dollars per channel per year for several years. At these costs, not many channels can be afforded for two-way video consultations. Nevertheless, there is considerable potential for development of techniques that would permit channel capacity, both audio and video, to be shared across a large number of users, thereby reducing the costs to each.

Recommendation 8: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development leading toward time-sharing and bandwidth-sharing techniques for more efficient use of audio and video channel capacity.

### 10.8.1 Time-Sharing on Audio Channels

As indicated earlier, the data communication techniques utilized in the experimental Aloha computer network in Hawaii, called packet contention techniques, have considerable promise for operational implementation in Alaska. large number of satellite ground stations (e.g., the 100 stations now being installed in Alaska) may all have access to the same audio bandwidth channel in the satellite. Each may transmit data in small "packets" addressed to any other ground station or ground stations in the network. If two or more locations transmit at the same time, thereby causing interference, those stations will retransmit the packet after a random delay time designed to minimize the possibility of interference a second time. This technique appears at this time to be

the most promising way of providing economical data communication from the small satellite ground stations being installed. Operational implementation of such data communication capability may provide major service advantages for the Alaska Area Native Health Service for reliable private transmission of computerized medical records and for performing administrative tasks, including ordering of supplies and maintaining inventory control. In principle, the cost of such a data communication system to the Indian Health Service, once implemented, should be comparable to or less than costs presently incurred for the IHS teletype network in Alaska.

> Recommendation 8a: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage and support research and development leading toward operational data communication services using time-shared narrow-band audio channels on communication satellites accessed by small ground stations.

10.8.2 Video Compression

Motion video signals contain a lot of redundancy. For any given picture "frame" the information could, in principle, be transmitted more efficiently by transmitting information only when one segment of the picture (for example, one dot in the television image) is different from the adjoining dot in the vertical or horizontal dimension. Similarly, for succeeding frames, information need only be transmitted when one of the dots is different from the comparable dot in the preceding frame. Some research is already being conducted into the "video compression" techniques necessary to take advantage of these redundancies and therefore permit reliable transmission of motion video images in real time, using less than the full channel capacity that would normally be required. In one research program directed by Dr. Dale Lumb at the NASA Ames Research Center (Mountain View, California), transformation techniques have been experimentally developed that permit intelligible video transmission with compression ratios as high as eight to one, thereby permitting, in principle, as many as eight video signals

to be transmitted through a single video channel. Unfortunately, the presently available techniques cause some degradation of video signal quality, require expensive signal processing equipment at both ends of the transmission, and are not designed for multipoint shared use of a channel as would be required if two different remote Alaska clinic locations wished to share the same video channel for medical consultation at the same time. More research and development will be necessary to permit economical sharing of video channels for medical consultation.

> Recommendation 8b: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development leading to economical video compression techniques permitting multiple locations to simultaneously share a single video channel.

10.8.3 Time-Sharing on Video Channels

Whether or not economical video compression techniques are developed to take advantage of the redundancies in motion video signals, it will be desirable to develop techniques for time-sharing of video channels so that multiple locations can share the same channel. Time-sharing principles analogous to those used in computer time-sharing could be applied to video channels. Techniques analogous to the "packet contention" data communication network discussed above, could be applied to a video bandwidth channel. Suppose each packet consisted of the equivalent of one "frame" of a video picture. (Television transmission of motion video requires 30 frames per second to be transmitted.) Suppose further that remote locations sometimes require transmission of only single frames (e.g., still picture transmission or X-ray transmission), sometimes require transmission of short sequences of motion video (e.g., to permit a consulting physician to observe the range of motion in an injured patient), and sometimes require transmission of longer video sequences to be transmitted simultaneously to a number of locations, but on a much lower priority basis (e.g., overnight

transmission of educational materials to be recorded on video cassettes at multiple receiving sites for later replay at times locally convenient). All of these applications might be shared on a single video channel, with time-sharing priority schemes that give higher priority to medical emergencies than to routine uses, higher priority to single-frame transmissions than to motion video, and higher priority to short video sequences than to long. This is analogous to some computer time-sharing algorithms in which short tasks take priority over long, but provision is made for priorities of service based on the kind of task to be performed or the rate the user is willing to pay. Given the high cost of satellite channels for video transmission and the even higher cost in Alaska of all the alternatives, operational implementation of two-way video telemedicine services may have to be delayed until techniques and terminals for video time-sharing have been developed.

> Recommendation 8c: The Lister Hill National Center for Biomedical Communication and the Indian Health Service should encourage or support research and development leading to economical video time-sharing techniques for shared use of satellite and other video communication channels.

## 10.9 SOCIAL AND HUMAN FACTORS IN TECHNICAL RESEARCH

One of the important benefits of field demonstration projects, such as the ATS-6 Alaska biomedical demonstration, is that better communication is established between the technical research and development community and the user communities their developments are intended to benefit.

The recommendations for technical research and development activities contained in the preceding sections followed from an examination of the social and economic possibilities for improvement of communication capability in support of health care delivery in Alaska. For technical research and development to be relevant to the health care delivery system, it is desirable to select the

research and development tasks in the light of the social and economic feasibility of implementation in actual health care delivery systems. A close coupling of health care system planning and technical research and development in support of that planning is more likely to lead to health care delivery system improvements than research that is motivated by technical possibilities.

Health care planners often do not understand technical issues and alternatives or the full cost implications of technical design. This is not surprising since they are trained in health rather than economics or engineering. Likewise, specialists in technical research and development may not fully understand the social and medical context in which their development, if successful, will be used. Consequently, health care system planners may take the available technology as a given, without understanding what alternatives are possible. Similarly, technical developers may concern themselves with only some of the "human factors" psychology relevant to making it easier for individuals to use equipment (e.g., location of knobs or kind of display of output). But they may be out of their depth when it comes to some of the larger social and economic issues that should be guiding their technical choices.

It is important to try to bridge this gulf between technical research and operational use, so that feedback and interaction take place. This was one consideration in urging (in Recommendations 7 and 8 above) that the Indian Health Service share responsibility for arranging that appropriate technical research be conducted, even though it may not have the mandate or the in-house capability to carry out such technical research.

Within the technical development activities, problems are likely to arise from social and environmental constraints and from problems in the interconnection of separately designed subsystems. These kinds of problems are difficult to detect and resolve in laboratory research and development activities. Therefore, it will pay to keep the larger physical, social, and economic

context clearly in mind throughout the research and development activity.

In the case of development activities intended to be of benefit to Alaska, the extreme environmental conditions obviously need to be taken into account. (Some of the technical outages during the ATS-6 demonstration were apparently attributable to a prolonged period of temperatures below -50 degrees Fahrenheit.) The absence of reliable power supplies in remote villages may lead to a requirement for operation of equipment by means of rechargeable batteries rather than assuming the availability of a reliable local source of power. Technical designs that permit limited use to continue when part of the system fails are also important. There should be access to all other sites when a single site fails. Reception capability should still be available when transmission fails. Local use of video equipment should still be possible when communication fails.

An important consideration in any technical development is overall system planning for effective integration into the local social and institutional environment. One example from the ATS-6 project was the inconvenience of mutual interference between ATS-1 and ATS-6 transmissions. In order to avoid audio feedback and interference it was necessary to turn down the sound volume of ATS-6 when ATS-1 was being used or vice versa. This could lead to minor inconvenience if the audio controls for the two systems were in different parts of the room, or if the system was being operated by a health care provider who had to focus his or her attention on the patient rather than on the system controls. With each of the two systems being implemented independently, it was all too easy to neglect to specify automatic cut-off circuits that would prevent the kind of mutual interference encountered. Many of the human factors problems of this sort stem from an insufficient perspective on the total system rather than from a lack of detailed psychological research on utilization of components or sub-systems.



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Local accessibility of facilities in both a physical and social sense may be a significant consideration for effective utilization but is one that cannot be dealt with in laboratory-based human factors studies. In Alaska, location of health care or communication facilities in the school may unnecessarily introduce social boundaries that will reduce access, even if there is little physical distance involved. This was not a problem in the ATS-6 project, but the ATS-1 project did provide evidence that utilization was greater when facilities were in the health aide's home or in a native-controlled clinic rather than in a school perceived by natives to be white-dominated.

System design that permits patient privacy, both on the communication channel and in the local setting, is also an important consideration. Ease of trouble-shooting (fault diagnosis) and ease of maintenance and repair are particularly important considerations, especially for remote Alaska locations where technicians are not locally available and weather conditions may prevent the travel of a technician to the community for a week or more.

Humans are able to accept a noticeable amount of inconvenience in order to have a service that they judge to be significant and important (as both ATS-1 and ATS-6 tended to be judged, although ATS-1 more so than ATS-6). If a system does not provide valuable and important services, then no amount of careful packaging of the human interface will compensate. Nevertheless, for those services judged to be valuable for health care delivery, it is important to plan systems that are easy to use and to plan for training programs as an integral part of the installation and operations procedures. It is even more important to involve system users and intended beneficiaries (e.g., Alaska natives) in the planning stages so that the designers can obtain relevant feedback as early in the process as possible.

> Recommendation 9: Technical research and development activities intended to improve the quality of health care should, like this ATS-6 project, have close contact with the physical, social, and human environments in which any resulting innovations are intended to be located.



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## APPENDIX A

## HEALTH INFORMATION SYSTEM FORMS

| ☐ 1. CHECK HERE IF SAME AS ABOVE | 2. VILLAGE | 3. DATE (MO/DAY/YR) | 4. PROVIDER | 5. CONSULTANT |
|---|---|---|---|---|

| 1 2 3 4 9<br>6. MEDIUM OF CONSULTATION | 1 2 3 4 5<br>7. CONTACT | 1 2 3 4<br>8. VOICE | 1 2 3 4<br>9. VIDEO |
|---|---|---|---|

| 10. PATIENT'S NAME | 11. SEX M F | 12. AGE | 13. PATIENT'S ID NO. |
|---|---|---|---|

14. SUBJECTIVE/ OBJECTIVE

15. ASSESSMENT 1st RE
1st RE

16. TREATMENT PLAN

| 1 2 3 4 5 6<br>17. COMPLEXITY | 1 2 3<br>18. DIAGNOSIS | 1 2 3<br>19. MANAGEMENT | 1 2 3 4<br>20. OUTCOME | 1 2 3 9<br>21. DEVICES USED | 1 2 3<br>22. TRAVEL REQUEST | 1 2 3<br>23. TRAVEL AUTH. |
|---|---|---|---|---|---|---|


| ☐ 1. CHECK HERE IF SAME AS ABOVE | 2. VILLAGE | 3. DATE (MO/DAY/YR) | 4. PROVIDER | 5. CONSULTANT |
|---|---|---|---|---|

| 1 2 3 4 9<br>6. MEDIUM OF CONSULTATION | 1 2 3 4 5<br>7. CONTACT | 1 2 3 4<br>8. VOICE | 1 2 3 4<br>9. VIDEO |
|---|---|---|---|

| 10. PATIENT'S NAME | 11. SEX M F | 12. AGE | 13. PATIENT'S ID NO. |
|---|---|---|---|

14. SUBJECTIVE/ OBJECTIVE

15. ASSESSMENT 1st RE
1st RE

16. TREATMENT PLAN

| 1 2 3 4 5 6<br>17. COMPLEXITY | 1 2 3<br>18. DIAGNOSIS | 1 2 3<br>19. MANAGEMENT | 1 2 3 4<br>20. OUTCOME | 1 2 3 9<br>21. DEVICES USED | 1 2 3<br>22. TRAVEL REQUEST | 1 2 3<br>23. TRAVEL AUTH. |
|---|---|---|---|---|---|---|



| ☐ 1. CHECK HERE IF SAME AS ABOVE | 2. VILLAGE | 3. DATE (MO/DAY/YR) | 4. PROVIDER | 5. CONSULTANT |
|---|---|---|---|---|

| 1 2 3 4 9<br>6. MEDIUM OF CONSULTATION | 1 2 3 4 5<br>7. CONTACT | 1 2 3 4<br>8. VOICE | 1 2 3 4<br>9. VIDEO |
|---|---|---|---|

| 10. PATIENT'S NAME | 11. SEX M F | 12. AGE | 13. PATIENT'S ID NO. |
|---|---|---|---|

14. SUBJECTIVE/ OBJECTIVE

15. ASSESSMENT 1st RE
1st RE

16. TREATMENT PLAN

| 1 2 3 4 5 6<br>17. COMPLEXITY | 1 2 3<br>18. DIAGNOSIS | 1 2 3<br>19. MANAGEMENT | 1 2 3 4<br>20. OUTCOME | 1 2 3 9<br>21. DEVICES USED | 1 2 3<br>22. TRAVEL REQUEST | 1 2 3<br>23. TRAVEL AUTH. |
|---|---|---|---|---|---|---|


FORM PTF 574

**ATS-6/HIS Outpatient Form**

Key to Symbols
S - Subjective
O - Objective
A - Assessment
P - Plan
# - HIS Problem Number

1. Time (Hr : Min) ☐☐ : ☐☐ AM/PM 3. Clinic ______
☐☐ : ☐☐ AM/PM 4. Disp: ______
6. ☐☐ : ☐☐ AM/PM 5. Residence:

2 Providers

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 01 GEN EXAMS | 03 EYE | 07 CHEST | 10 HERNIA | SPEC EXAMS | 16 GEN DVL | 19 VISION |
| | 04 MOUTH | 08 HEART | 11 NEUROL. | 14 RECTAL | 17 HEARING | 20 SEX DVL. |
| 02 EAR | 05 NECK | 09 ABDOMEN | 12 ORTHO | 15 PELVIC | 18 EYE MB | 06 BREAST |

9. SUBJECTIVE/OBJECTIVE

7. Lab/X-Ray
# #

| | | | |
|---|---|---|---|
| | 02560 UA T MIC | | 05041 URINE Cult. |
| | 02561 UA T MIC | | 81512 K |
| | 04068 WBC | | 01602 Na |
| | 04230 Hct | | 05045 AFB Cult. |
| | 04231 Hemoglob | | 05043 SPUTUM Cult. |
| | 01661 BUN | | 05044 THROAT Cult. |
| | 01208 BS | | 05048 GC Cult. |
| | 01210 Mod Gtt | | 08162 RPR |
| | 01033 BILI | | 05042 STOOL Cult. |
| | 01145 ALK P | | 08460 Stool Occ Bl |
| | 01147 SGOT | | 15130 ECG |
| | 01663 URIC A | | 10062 PAP |
| | 01670 SMA-12 | | 15231 Chest X-R |
| | 15235 IVP | | 15234 GB Series |
| | 15236 UPPER GI | | 15237 Barium En. |

HT (INS)

WT. (LBS)-(OZ.)

TEMP. (°F) R O A

B/P

PULSE | RESP

HEAD (INS)

VISION-UNCORR. R | L

VISION-CORR R | L

TONOMETRY R | L
Load
Reading

If TB TEST INDICATE → 1 ROUTINE 2 SUSPECT 3 CONTACT 4 SCHOOL

20 TINE mm 21 PPD mm

19. SATELLITE EVALUATION
Consult Desired — Not Accomplished
2 - No 3 - Aud 4 - TV
Audio 1 2 3 9
Video 1 2 3 9
CONSULT DATE - Time 1 - AM 2 - PM M.D. Medium of Consult 1 2 3 4 9
Quality Voice 1 2 3 4
Quality TV 1 2 3 4
Symptom Time Days: Hours:

| Add Chng | Prob. No. | STATUS | | | | 11. ASSESSMENT/PROBLEM NARRATIVE | 1st | Rev. | Prob./Diag. | Injury |
|---|---|---|---|---|---|---|---|---|---|---|
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |

| | 12. OPERATIONS/PROCEDURES | | |
|---|---|---|---|
| # | | ICDA | OPER. / DIAG. |
| # | | ICDA | OPER. / DIAG. |

| | 13. PLAN/IMMUNIZATIONS, MEDICATIONS, TREATMENTS | # of Refills | FORMULARY CODE |
|---|---|---|---|
| # | | | |
| # | | | |
| # | | | |
| # | | | |
| # | | | |
| # | | | |

14. All Prenatal & 1st Family Planning
Gravida ______ 1. Married
Liv Children ______ 2 Not Married

Trimester of Visit (1st Prenatal) 1 2 3

EDC (Current) All prenatal visits

METHOD (All Family Planning) 1. Oral 2. IUD 3. Rhythm 4. Other 5. Infertility Coun. 6. General Coun. 7. Surgical Steril.

STATUS 1. Start 2. Restart 3. Continue 4. Discontinue 5. Discontinue - Preg.

15. IDENTIFICATION
NAME ______ LAST FIRST M.I.
B.DATE ______ SEX ______
I.D.NO. ______
S.S.NO. ______
RESIDENCE ______
LOCATION OF ENCOUNTER ______

DA
PO

16. REFER (Circle "REFER" For HIS Pick-up)
TO: ______ Date: ______ Prb#: ______ Priority: 1 2 3
Purpose: ______

17. REVISIT (Circle "REVISIT" for HIS Pick-up)
Hour: ______ Date: ______ Prb#: ______ Priority: 1 2 3
Purpose: ______

18. Sig.

# ATS-6 HEALTH AIDE FORM

Key to Symbols
S - Subjective
O - Objective
A - Assessment
P - Plan
# - HIS Problem Number

1. SUB./OBJ. DATA

2.

4.

5.

| | |
|---|---|
| | 02580 UA ī Mic |
| | 04231 Hemoglob. |
| | 05044 Throat Cult. |
| 20 TINE | mm |
| 21 PPD | mm |
| | 11 Measles |
| | 14 Rubella |
| | 15 Mumps |
| | 02 DT 1 2 3 B |
| | 03 DPT 1 2 3 B |
| | 06 OPV 1 2 3 B |

3. MEASUREMENTS

| | |
|---|---|
| HT (INS) | |
| WT. (LBS)-(OZ.) | |
| TEMP.(°F) R O A | |
| B/P | |
| PULSE | RESP |
| HEAD (INS) | |
| VISION-UNCORR. R | L |
| VISION-CORR. R | L |

| Add Chng | Prob. No. | Status | | | | 6. ASSESSMENT/PROBLEM NARRATIVE | | | Prob./Diag. | Injury |
|---|---|---|---|---|---|---|---|---|---|---|
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |
| | # | 1 | 2 | 3 | 4 | | | | | |

7. TREATMENT PLAN/TREATMENT If drug given, tell drug name, how administered, how much each dose, how often, and how much was given to patient.

| 8. CONSULT DESIRED | 9. CONSULT NOT ACCOMPLISHED | 10. CONSULT DATE | 11. CONSULT TIME |
|---|---|---|---|
| 1 - YES 2 - NO | 1 - Patient Refused 3 - No Available Time<br>2 - Technical Problem 9 - Other | | 1 - AM 2 - PM |

| 12. VOICE QUALITY | 13. Symptom or Contact Time |
|---|---|
| 1 - Inadequate 3 - Satisfactory<br>2 - Marginal 4 - Excellent | Days: Hours: |

14. IDENTIFICATION

NAME

B.DATE SEX

I.D.NO.

S.S.NO.

RESIDENCE

[illegible]AGE OF ENCOUNTER

TIME:

15. REFER (Circle "REFER" For HIS Pick-up)

To: Date: Prb#:

Purpose:

16. REVISIT (Circle "REVISIT" for HIS Pick-up)

Hour: Date: Prb#:

Purpose:

17. Sig.



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# APPENDIX B

# ANCHORAGE MONITORING LOG



ERIC
Full Text Provided by ERIC

ATS-6 MONITORING LOG

(1) DATE:________________ (2) START TIME:__________ AM PM

(3) STATIONS INVOLVED IN THIS INTERACTION

| ANCHORAGE | FAIRBANKS | FT. YUKON | GALENA | TANANA |
|---|---|---|---|---|
| P A L N U | P A L N U | P A L N U | P A L N U | P A L N U |

(4) SIGNAL QUALITY

| ATS-6 PICTURE | ATS-6 SOUND | ATS-1 SOUND |
|---|---|---|
| 1 2 3 4 | 1 2 3 4 | 1 2 3 4 |

(5) PATIENT: Village of Residence__________________ HIS Number__________ Age_____ Sex M F

(6) IS THIS CONSULT A FOLLOW-UP OF: ATS-1 ATS-6 (7) SYMPTOM TIME____________

(8) INTERACTION TYPE: C CT A T OTHER____________________

(9) CONSULTANTS

| Name | Speciality | Location |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

(10) DIAGNOSTIC EQUIPMENT: X RAY_____ STETHOPHONE___ TELE-EKG___ OTHER____________

(11) CONTENT: (Use SOAP Format) ____________________

(12) DIAGNOSIS: 1 2 3 (13) MANAGEMENT: 1 2 3 (14) OUTCOME: 1 2 3 4

(15) WAS VIDEO DIFFERENT THAN AUDIO-ONLY WOULD HAVE BEEN? 1 2 3 4 5

(16) STOP TIME______________ AM PM (17) ELAPSED TIME__________

(18) MONITOR'S NAME______________ (19) LOCATION__________________

(20) COMMENTS____________________________________________



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ATS-6 MONITORING LOG CODES

(3) P = Presenting patients
A = Actively participating
L = Listening
N = Not tuned in
U = Unknown

(4) 1 = Totally inadequate
2 = Marginally adequate
3 = Satisfactory
4 = Excellent

(8) C = Consultation about an individual patient
CT = Clinic-type use
A = Administrative use
T = Training

(12) & (13) 1 = No change
2 = Minor change
3 = Significant change

(14) 1 = No effect
2 = Some effect
3 = Definite effect
4 = Marked effect

(15) 1 = Absolutely critical (Explain in "Comments")
2 = Much better
3 = Slightly better
4 = No different
5 = Worse (Explain in "Comments")

1 VILLAGE | DATE (MO DAY) | SEX of pt (1 = male, 2 = female) | AGE of pt | 210 TANANA doctors | LOCAL PROVIDER: 1 NURSE, 2 MEDIC, 3 COMMUNITY HEALTH AIDE, 4 OTHER

2 1° dx

2° dx

# APPENDIX C

## TANANA MONITORING LOG

3 Dr. CODE | TYPE OF VISIT 0-3 | TRAVEL PLANS 0-4 | SEVERITY 0-8 | MANAGEMENT 0-3 | OUTCOME 0-4

4 SPECIALISTS CONSULTED

CHANGE IN DX BY SPECIALIST 0-3 AS PER MANAGEMENT

01 MEDICINE
02 PEDIATRICS
03 DERMATOLOGY
04 RADIOLOGY
05 HEMATOLOGY
06 NEUROLOGY
07 PSYCHIATRY
08 GENERAL SURGERY
09 OBSTETRICS-GYNECOLOGY
10 OPTHALMOLOGY
11 NEUROSURGERY
12 ORTHOPEDICS
13 OTOLARYNGOLOGY
14 UROLOGY
15 PLASTIC SURGERY
16 GENERAL PRACTICE
17 CARDIOLOGY
18 OTHER

5 DURATION OF SYMPTOMS | TIME BETWEEN ONSET AND SEEKING HELP AT STATION | TIME BETW SEEKING LOCAL AIDE AND ATS-6 TRANSMISSION

00 - DON'T KNOW, NOT RELEVANT
01 - 1 day or less
02 - BETW 1 AND 2 DAYS
99 - CHRONIC, CONGENITAL

6 TIME OF TRANSMISSION | MINUTES ON ATS-6 | TRANSMISSION COMPLETED: 01 COMPLETED, 02 TIME RAN OUT

7 SPECIAL EXAM: 1 EKG, 2 X-RAY, 3 STETHES., 4 CLOSE-UP

8 SUFFICIENCY OF TRANSMISSION: 1 TOTALLY INADEQUATE, 2 MARGINALLY ADEQUATE, 3 SATISFACTORY, 4 EXCELLENT | ATS-6 picture 1-4 (great) | ATS-6 SOUND 1-4 | ATS-1 SOUND 1-4 | PICTURE IMPORTANT: 1 ABSOLUTELY CRITICAL, 2 MUCH BETTER, 3 SLIGHTLY BETTER, 4 NO DIFFERENT, 5 WORSE

9 TREATMENT(S) RECOMMENDED

1 DRUGS
2 MECHANICAL eg. splint, bandage, sew,
3 PT. INSTRUCTION eg wash, soak, elevate
4 WATCHFUL WAITING
5 TRANSPORT TO TANANA
6 TRANSPORT TO FAIRBANKS
7 TRANSPORT TO ANCHORAGE
8 OTHER

10 FOLLOW-UP REQUESTED: 1 NONE, 2 BY TANANA, 3 BY LOCAL AIDE, 4 BY ANCHORAGE

11 PRESENCE OF PT.

1 pt absent
2 pt present w/o participation (eg. could as well as not have been there)
3 pt present w visual particip (was looked at)
4 pt present w visual + audio particip

12 TAPE REVIEWED BY CONSULTANT: 00 not reviewed later, 01, 02 etc

CHANGE IN MANAGEMENT BY TAPE CONSULTANT 0-3 as per management

13 TRANSLATOR USED: 1 YES, 2 NO | CONTACT PRIOR TO TRANSMISSION: 0 NONE, 1 phone, 2 ATS-1, 3 ATS-6, 4 HF RADIO | FOLLOW-UP: 0 NONE, 1 PHONE, 2 ATS-1, 3 ATS-6, 4 HF RADIO

14 | 15 | 16 | 17

CODER:

APPENDIX D

## CASE SUMMARY PROTOCOL

Do detailed follow-up on all patients participating in Telemedicine during his stay at Tanana.

1. Clinical Summary of Interaction--Look for the following and document

   a. Apparent change in diagnosis or plan resulting from the interaction
   b. Change in travel plan, i.e., aide/RN did or didn't want transfer
   c. Special examinations or testing done at direction of consultant i.e., looked directly at injured part or asked RN to test reflexes or the like
   d. Characterize any direct contact with the patient on part of Tanana M.D. or by voice from A.N.M.C.

2. Summary of existing H.I.S. on patient seen

   a. Review and summarize records on patient available at Tanana
   b. Check H.I.S. data in system; summarize

3. Immediate Follow-up--to be done the following day after TV contact (by phone)

   a. Contact remote provider at either Galena or Fort Yukon and obtain qualitative assessment of interaction

      (1) did you get the consultant you wanted
      (2) did you get the information/help you wanted
      (3) was the result satisfactory in your assessment
      (4) has anything happened since the contact to change the resultant plan
      (5) how did you decide to the put the patient into the system: just occurred at right time; patient asked for it; complexity of problem; wanted to fill up time with something; personal educational value
      (6) do you feel you did anything different in managing patient after the consultation?
      (7) please describe patient's response to the consultation.

   b. If patient was transferred, contact the physician/provider at appropriate institution (Tanana, ANMC, Fairbanks) and determine events after teleconsultation

      (1) was diagnosis/severity accurately assessed at time of teleconsultation
      (2) was decision to transfer an appropiate one
      (3) has patient progressed satisfactorily since transfer
      (4) any comments on effect of teleconsultation
      (5) did patient make comments to you about teleconsultation?

4. Long-term Follow-up

   a. Call,if appropriate, both local and hospital providers; determine length of hospital stay

   ? to depend on previous information

   Suggest this be done in two weeks

   ?? Interview patients.

## APPENDIX E

## PROVIDER INTERVIEW PROTOCOL

### ATF-S Health Provider Interview Schedule

A. Personal Data

1. Name ________________

2. Occupation ________________ 3. Years in this position _____

4. Years in other similar jobs ________________

5. Years in this community _______ 6. Years in Alaska ________

7. Work schedule: on call 24 hr./day _____ 8-5 wkends off _______
   other: ________________

8. Work location: hospital ____ clinic ____ home ____
   other: ________________

B. Communication Facilities

9. Which of these communication facilities or media do you have in your community? (check)

_____ HF radio: specify owner(s) and location(s) ________________

________________

_____ telephone: cost/3 min. call to Fairbanks ________________

_____ satellite radio

_____ broadcast radio: from: ________________

_____ television: source, hours/day ________________

_____ movies: how often, where? ________________

_____ newspapers: how obtain? ________________

_____ magazines: how obtain? ________________

_____ books: how obtain? ________________
is there a library? ___________ where? ___________

________________



ERIC

C. Current Practice

10. On the average, how many patients do you see each day? ________

________________________________________

11. What percent are _____0-15 yr.

_____16-30 yr.

_____ over 30

12. What are the three health problems you see most regularly?

a. ________________________________________

b. ________________________________________

c. ________________________________________

D. The Health Care System

13. Where do people in this community go for health care?

| | % | Remarks: Why this choice? |
|---|---|---|
| PHS nurses | ____ | ________________ |
| health aide | ____ | ________________ |
| State Public Health Nurse | ____ | ________________ |
| private (specify MD, medex) | ____ | ________________ |
| military | ____ | ________________ |
| other | ____ | ________________ |

14.

a. Generally speaking, how satisfied do you think people here are with the health care they get? (circle)

very satisfied     satisfied     unsatisfied     very unsatisfied

don't know

b. Why do you think they feel this way?

________________________________________

________________________________________

________________________________________

15.

a. If people could get their health care anywhere they wanted without problems, where do you think they would go? (If more than one answer, show % or which groups would choose each.)

| | | | |
|---|---|---|---|
| PHS nurse | _____ | medex | _____ |
| health aide | _____ | military | _____ |
| State public health nurse | _____ | other | _____ |

b. Why would they make this choice? ______________________________

______________________________________________

______________________________________________

16.

a. How would you rate the health care given to people here?

excellent good fair poor don't know

17.

a. What are the best features of the health care system?

______________________________________________

______________________________________________

______________________________________________

b. What are its weakest points?

______________________________________________

______________________________________________

______________________________________________

## E. Health Problems

18.

a. What do you think is the major health problem in this community?

______________________________________________

______________________________________________

______________________________________________

b. Do you think this problem is being handled satisfactorily?

Yes _____ No _____



ERIC

c. <u>If no</u>, what additional steps or changes would you recommend?

______________________________________________

______________________________________________

______________________________________________

19. What do people here think is the major health problem in the community?

______________________________________________

______________________________________________

F. <u>Community Problems</u>

20. Considering all the needs and problems people have here, what do you think is the single greatest need or problem in the community?

______________________________________________

______________________________________________

21. What do people here think is the greatest need or problem in the community?

______________________________________________

______________________________________________

G. <u>Consultation</u>

<u>For aides and nurses</u>: (<u>for doctors go to question 26</u>).

22. For about what percent of your patients do you consult with a doctor? __________%

23. How do you usually do this? (If more than one, get % of each.)

_____ by telephone

_____ by satellite radio

_____ by satellite video

_____ in person

_____ other

24. About how much time per day do you spend consulting with the doctor? ______________________

25. Do you tell the patient when you are going to consult with the doctor? Yes ________ No ________

For doctors:

26. About how much time per day do you spend consulting with remote aides and nurses on patients?

_______________

27. How do you usually do this? (If more than one, get % of each.)

    ______ by telephone

    ______ by satellite radio

    ______ by satellite video

    ______ in person (on field visits only)

H. ATS-1

28. How long have you used the ATS-1 satellite radio? ______________

_______________

29. How did you get consultations before that? ______________

_______________

30. What difference has the possibility of radio consultation made to your ability to provide health care?

_______________

_______________

31. What particular features do you like about the ATS-1 system?

_______________

_______________

32. What particular features don't you like about the ATS-1 system?

_______________

_______________

33. What diseases or health problems are best handled over ATS-1?

_______________

_______________

34. Are there some diseases or problems which are difficult to handle over ATS-1?

_______________

Why? _______________

_______________

_______________

35. How do patients feel about having their names used over the system?

______________________________________________

______________________________________________

36. The following are some of the functions provided by ATS-1:

- emergency consultation
- daily doctor call
- administration, ordering supplies
- contact with others doing this job
- teaching about patient care

a. Could ATS-1 be used more effectively for these or other functions? Yes ______ No ______

If yes, how? ______________________________________________

______________________________________________

______________________________________________

b. What additional services should be provided on ATS-1?

______________________________________________

______________________________________________

______________________________________________

I. ATS-F

37. About when will the ATS-F project using two-way television begin?

______________________________________________

38. How much time will the satellite be available each week for health use?

______________________________________________

39. Do you think you have received enough information:

a. -about what the project will do? Yes _____ No ______

b. -about your part in the project? Yes _____ No ______

c. -about how to use the Health Information Systems forms? Yes _____ No ______

If no to a, b, or c: What else would you like to know?

______________________________________________

______________________________________________

______________________________________________

40. Do you think two-way video via ATS-F will help you provide better health care? Yes _____ No _____

Why or why not? ______________________________

______________________________

______________________________

41. What diseases or problems do you think will be best handled using video?

______________________________

______________________________

______________________________

42. What problems do you think you will have using the two-way video system?

______________________________

______________________________

______________________________

43. How do you think your patients will react to being seen by a doctor via television?

______________________________

______________________________

______________________________

44. How else do you think video could be used for health care?

______________________________

______________________________

______________________________

45. How else could television be used in general in the community?

______________________________

______________________________

______________________________

46. Do you think the availability of broadcast television would/has:

a. reduce(d) the rate of alcoholism in this community?

Yes ______ No ______

b. improve(d) the mental health of this community?

Yes ______ No ______

Comments: ______________________________

(continued)

J. HIS forms

47. How long have you used the problem-oriented record system? ______

48. How useful do you find it compared to the records you kept before?

more useful    about as useful    not as useful    don't know

Why? ______

49. What problems have you had with the system? ______

50. Do you think the system will help you to provide better health care?    Yes ______    No ______

Why? ______

51. Has the HIS record system affected your work in any of the following ways? (circle response)

| | | | | |
|---|---|---|---|---|
| a. work keeping records | more | same | less | too soon to tell |
| b. information about patients | better | same | worse | too soon to tell |
| c. monitoring chronic conditions | easier | same | harder | too soon to tell |
| d. control of scheduled repeat visits | better | same | worse | too soon to tell |
| e. drug prescription/dispensing | easier | same | harder | too soon to tell |
| f. knowledge of patient drug use | more | same | less | too soon to tell |
| g. confidence in doing your job | greater | same | less | too soon to tell |
| h. getting patient records | easier | same | harder | too soon to tell |
| i. other ______ | | | | |

## K. Opinions on Communication Requirements

Your opinions are important because the satellite projects are designed to help learn what kind of communication Alaskans need in the villages. The ATS-F project for television will last only nine months. And the ATS-1 satellite for radio is old now and could stop working any time. We need to know what kind of continuing communication services people need.

52. You have said that the most major health problem of people here is (see question 18).

    a. Do you think the satellite radio has helped to attack that problem? Yes _____ No _____

    Why or why not? ______________________________________________

    ______________________________________________________________

    b. Do you think two-way television for health care will help to attack this problem? Yes _____ No _____

    Why or why not? ______________________________________________

    ______________________________________________________________

53. You have said that the most important need or problem of people here is (see question 20).

    a. Do you think the satellite radio helped to attack this problem in any way? Yes _____ No _____

    Why or why not? ______________________________________________

    ______________________________________________________________

    b. Do you think two-way video for health care will help to attack this problem? Yes _____ No _____

    Why or why not? ______________________________________________

    ______________________________________________________________

54. You have said that the weakest points of the health care system are (see question 17).

    a. Do you think the satellite radio helped to strengthen these points in any way? Yes _____ No _____

    Why or why not? ______________________________________________

    ______________________________________________________________

b. Do you think two-way video will help to strengthen these points?

Yes _____ No _____

Why or why not? ______________________________

______________________________

55. Do you think any other improvements in communication would help to attack the health problems, community problems, or health system problems you have mentioned? Yes _____ No _____

If yes, what kind? ______________________________

______________________________

If no, what else should be done? ______________________________

______________________________

______________________________

______________________________

______________________________

______________________________

56. Do you have any other comments or suggestions you would like to make?

______________________________

______________________________

______________________________

______________________________

57. Would you like more information on anything we have talked about?

______________________________

______________________________

______________________________

______________________________

APPENDIX F

CONSUMER INTERVIEW PROTOCOL

## ATS-F Evaluation Questionnaire

We want the satellite projects to help us learn what kind of communication Alaskans need in the villages. The ATS-F satellite television probject will last only nine months, and the ATS-1 radio satellite is old now and could stop working any time. We need to know what kind of continuing communication services people need. Your opinion is very important.

Your name is for identification purposes only. It will not be used in any study or report.

Name____________________ Home Town____________________

How long have you lived there?____________________

1. Which of these communication facilities or media do you have in your community? (Check all appropriate)

_____ Telephone

_____ HF radio-telephone

Who owns the radio(s)? ____________________

Where are they located?____________________

_____ Satellite radio (ATS-1)

_____ Broadcast commercial radio

From what places?____________________

_____ Television

How many hours per day?____________________

_____ Movies

How often?_______________

Can you buy in your community:

_____ Newspapers

_____ Magazines

_____ Books



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ATS-F Evaluation Questionnaire

Is there a library? _____ Where? ____________________________

2. Where do native people in your community go for health care?

About ______% to PHS

About ______% to private services (doctors, medex, etc.)

3. a. Generally speaking, how satisfied do you think people are most of the time with the health care they get?

Very satisfied ______ Satisfied ______

Unsatisfied ______ Very unsatisifed ______ Don't know ______

b. Why do you think they feel this way?

____________________________________________

____________________________________________

____________________________________________

4. a. If people could have free private medical care or IHS medical care, where do you think they would go?

____________________________________________

____________________________________________

b. Why would they make this choice? ____________________

____________________________________________

____________________________________________

5. How would you rate the health care given to people in your community?

Excellent___ Good___ Fair___ Poor___ Don't Know___

6. a. What do you think is good about the health care provided to the people in your community?

____________________________________________

____________________________________________

____________________________________________

ATS-F Evaluation Questionnaire

6. b. What do you think is the weakest or worst part about the health care provided to the people in your community?

______________________________

______________________________

______________________________

c. Do you think the ATS-1 satellite radio helped to strengthen these points in any way?

Yes _____ No_____ Don't know_____

Explain______________________________

______________________________

d. Do you think the ATS-F satellite television will help to strengthen these points in any way?

Yes_____ No_____ Don't know_____

Explain______________________________

______________________________

7. How would you rate the attitudes of health care staff in your community toward native people?

Excellent_____ Good_____ Fair_____ Poor_____

Comments______________________________

______________________________

______________________________

8. a. What do you think is the main health problem in your community?

______________________________

______________________________

______________________________

b. Do you think this problem is being handled satisfactorily?

Yes _____ No_____ Don't Know_____



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ATS-F Evaluation Questionnaire

8. c. If no, what do you think should be done to deal with the problem?

______________________________

______________________________

______________________________

d. Do you think the ATS-1 satellite radio has helped to deal with that problem in any way?

Yes ____ No ____ Don't know ____

Explain ______________________________

______________________________

e. Do you think the ATS-F satellite television for health care will help deal with this problem in any way?

Yes ____ No ____ Don't know ____

Explain ______________________________

______________________________

9. a. Considering both health needs and all the other needs and problems that people have, what do you think is the single greatest need or problem in your community?

______________________________

______________________________

______________________________

b. Do you think the ATS-1 satellite radio helped to deal with this problem in any way?

Yes ____ No ____ Don't know ____

Explain ______________________________

______________________________

c. Do you think the ATS-F satellite television for health care will help to deal with this problem in any way?

Yes ____ No ____ Don't know ____

Explain ______________________________

______________________________

ATS-F Evaluation Questionnaire

10. Are there any changes in communication which would help to deal with the health problem, community problems, or health system problems you have mentioned?

    Yes_____ No_____ Don't know_____

    Explain________________________________________

    ________________________________________

    ________________________________________

11. What particular features do you like about the ATS-1 radio satellite system?

    ________________________________________

    ________________________________________

12. What particular features do you not like about the ATS-1 radio satellite system?

    ________________________________________

    ________________________________________

13. How do patients feel about having their names used over the ATS-1 radio satellite system?

    Most people don't mind________ Most people do mind______

    Don't know_____

14. How much time will the satellite television be available each week for health use?

    ________________________________________

15. How much time will the satellite television be available to your community each week for education programs?

    ________________________________________

16. Do you think you received enough information:

    a. about what the ATS-F project will do? Yes____ No____

    b. about your part in the project? Yes____ No____

    c. about the Health Information Systems (HIS) forms? Yes____ No____

16. If no to a, b, or c: What else would you like to know?

______________________________________________

______________________________________________

17. Do you think ATS-F satellite television will help provide better health care to patients:

A lot better____ A little better _____ No different _____

Not as good _____ Don't know_____

18. What problems do you think there will be with the satellite television?

______________________________________________

______________________________________________

______________________________________________

19. How do you think the patients will react to being seen by a doctor on satellite television?

Like it a lot_____ Think it doesn't matter_____ Not like it_____

Don't know_____

20. Do you think the availability of regular broadcast television --

a. Changes peoples understanding of health in any way.

Much change_____ Some change_____ No change_____ don't know_____

b. Reduces the rate of alccholism in the community

Much_____ Some_____ No change_____ Don't know_____

c. Improves the mental health in the community

Much _____ Some _____ No change _____ Don't know_____

21. Do you think the HIS record system will help provide better health care?

A lot____ A little____ No different____ Not as good_____ Don't know_____

Why?______________________________________________

______________________________________________



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ATS-F Evaluation Questionnaire

21. What problems do you think there will be with the HIS system?

_______________

_______________

_______________

22. Are there other ways you think satellite television could be used for health care?

_______________

_______________

23. Are there other ways satellite television could be used in the community (besides health care)?

_______________

_______________

24. Of all the different communication equipment available, which do you think the people in your community would most like to have for regular use? Check one:

Television: Regular_____ Health_____ Education_____

Radio: Local station_____ Health_____ Education_____

Telephone_____

Better Mail Service_____

Other_______________

Comments:_______________

_______________

25. Do you have any other comments or suggestions you would like to make about health care, community problems, or communications?

_______________

_______________

_______________

_______________



ERIC

DATE: 29 JULY 1973

ON: OFF: | ON: OFF: | ON: OFF: | ON: OFF:

S.I. = SUNDAY

| STATIONS | Participation * | Signal | Program Content | Participation * | Signal | Program Content | Participation * | Signal | Program Content | 1st Transmission to Tanana | Signal | No. Patients Treated | Time Used For Treatment | No. Other Medical Matters | Total Elapsed Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Allakaket | | | | | | | | | | 1919 | 5x5 | 0 | | 1 | 1 |
| Anaktuvuk Pass | | | | | | | | | | 1920 | 5x5 | 0 | | 0 | |
| Arctic Village | | | | | | | | | | | | | | | |
| Beaver | | | | | | | | | | 1921 | 5x5 | 2 | 4 | 0 | 4 |
| Chalkyitsik | | | | | | | | | | 1926 | 5x4 | 0 | | 2 | 3 |
| Eagle | | | | | | | | | | | | | | | |
| Fort Yukon | | | | | | | | | | 1930 | 5x5 | 0 | | 3 | 2 |
| Hughes | | | | | | | | | | | | | | | |
| Huslia | | | | | | | | | | 1932 | 5x5 | 2 | 10 | 0 | 10 |
| Koyukuk | | | | | | | | | | 1942 | 4x4 | 0 | | 1 | 1 |
| Nulato | | | | | | | | | | 1943 | 5x5 | 2 | 6 | 0 | 6 |
| Ruby | | | | | | | | | | 1951 | 5x4 | 1 | 1 | 2 | 2 |
| Stevens Village | | | | | | | | | | 1953 | 5x5 | 0 | | 1 | 1 |
| Venetie | | | | | | | | | | 1954 | 5x5 | 0 | | 1 | 1 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Tanana | | | | | | | | | | 1919 | 5x5 | | | | 40 |
| Saint Paul | | | | | | | | | | | | | | | |
| Anchorage | | | | | | | | | | | | | | | |
| College | | | | | | | | | | | | | | | |
| Juneau | | | | | | | | | | | | | | | |

NOTES:

APPENDIX G

SAMPLE MINITRACK LOG

* A = Active Participation
L = Just Listening